

Song Thu Bon

Map of River

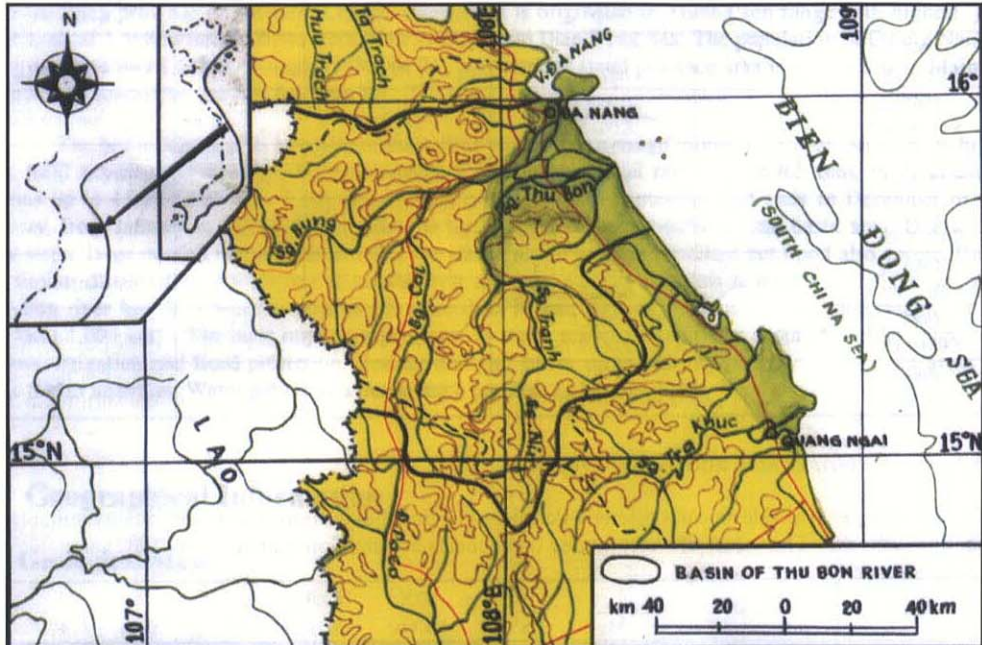
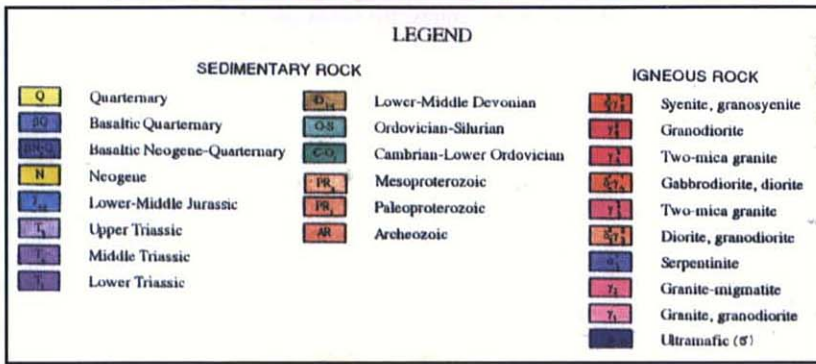
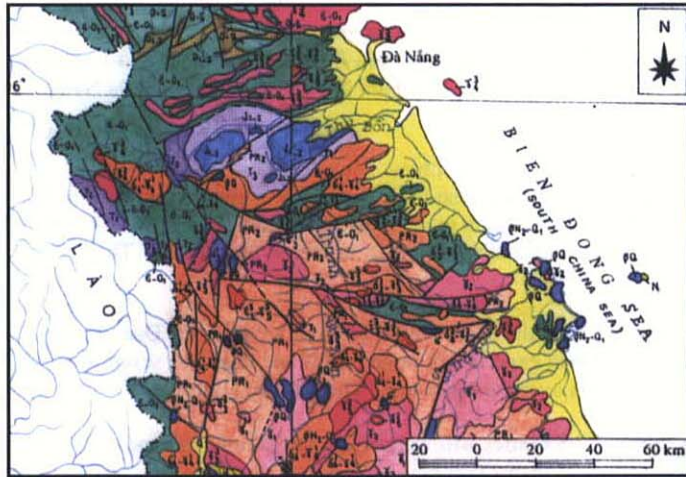


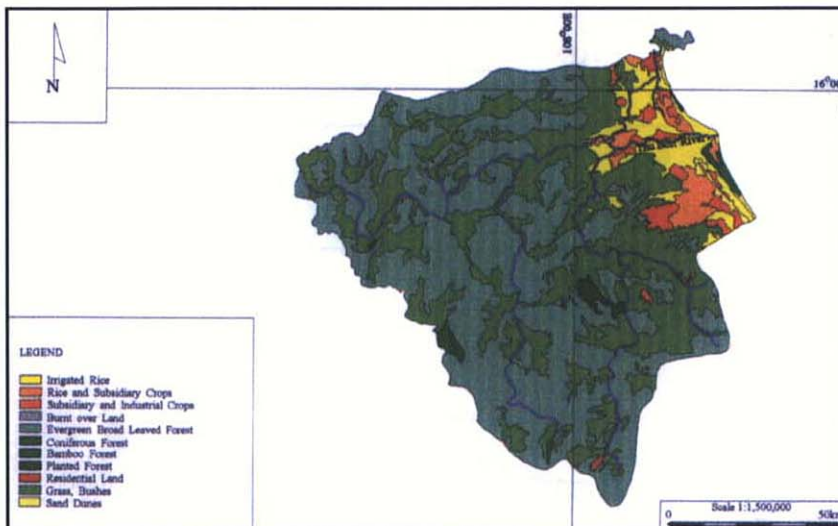
Table of Basic Data

| | | |
|---|--|------------------------------|
| Name: Thu Bon River | | Serial No.: Vietnam-2 |
| Location: Quang Nam-Da Nang Province, Vietnam | N 14° 46' ~ 16° 05' | E 107° 12' ~ 108° 20' |
| Area: 10 350 km ² | Length of main stream: 205 km | |
| Origin: Mt. Mang (1600 m) | Highest point: Mt. Ngoc Linh (2598 m) | |
| Outlet: Bien Dong Sea (South China Sea) | Lowest point: River mouth (0 m) | |
| Main geological features: Granite, Conglomerate, Limestone, Sandstone, Brown soil | | |
| Main tributaries: Giang River (496 km ²), Bung River (2 530 km ²), Tinh Yen River (3 690 km ²) | | |
| Main lakes: None | | |
| Main reservoirs: Khe Tan Reservoir (54.3 x 10 ⁶ m ³), Phuoc Ha Reservoir (4.8 x 10 ⁶ m ³), Vinh Trinh Reservoir (21.8 x 10 ⁶ m ³) | | |
| Mean annual precipitation: 2 763 mm | | |
| Mean annual runoff: 242 m ³ /s at Nong Son (3 155 km ²) (1976~1992) | | |
| Population: 1 688 000 (1985) | Main cities: Da Nang, Hoi An | |
| Land use: Forest (52.7%), Rice paddy (8.3%), Other agriculture (2.3%), Grass (35.9%) | | |

2. Geographical Information
 2.1 Geological Map



2.2 Land Use Map



1. General Description

The Thu Bon River is 205 km in length and its catchment area is entirely within the Quang Nam-Da Nang Province in south-central Vietnam. It originates in Truong Son range with the highest peak Ngoc Linh of 2 598 m, and runs from west to east draining an area of 10 500 km² before flowing out into Bien Dong Sea. In 1985, the Quang Nam-Da Nang Province (area 11 989 km²) had a population of 1 688 000, or 141 persons/km². The main city in the province is Da Nang, and the townships are Hoi An and Tam Ky.

The basin is located in a region without a well defined winter season. The average minimum temperature is higher than 10°C. The basin is also the wettest in south-central Vietnam with a mean annual rainfall of 2 763 mm, which in the mountainous areas range from 4 000~5 000 mm. The rainy season begins in August/September and ends in December/January. The dry season is from January to July.

Approximately 40~60% of the basin area is covered with forest. Due to steep slopes, heavy rainfall and forest cover, the basin experiences large runoff and therefore severe floods. Rainfall and runoff have similar distribution over the basin area. The specific discharge is mostly over 6.0 m³/s/100 km².

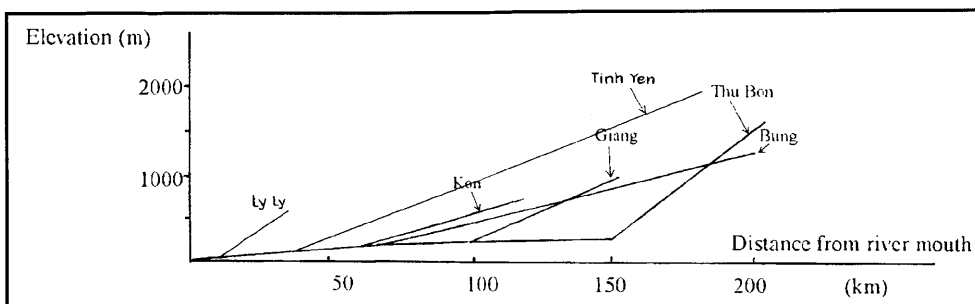
Thu Bon River has 78 tributaries with lengths greater than 10 km and 90% of such rivers and creeks have catchment areas less than 1,000 km². The most important water resources problems in the basin are water supply for cities and population centres, irrigation and flood protection. Other problems include drought, storm surges, salinity intrusion, and more recently, water pollution in Da Nang city.

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 | Thu Bon (Main river) | 205 10 350 | 1 600 ----- | Q.Nam- Da Nang | A (2.3) F (52.7) |
| 2 | Giang (Tributary) | 62 496 | 1 000 ----- | | G (35.9) P (8.3) |
| 3 | Bung (Tributary) | 131 2 530 | 1 300 ----- | | |
| 4 | Con (Tributary) | 47 627 | 800 ----- | | |
| 5 | Tinh Yen (Tributary) | 163 3 690 | 2 000 ----- | | |
| 6 | Ly Ly (Tributary) | 38 279 | 525 ----- | | |

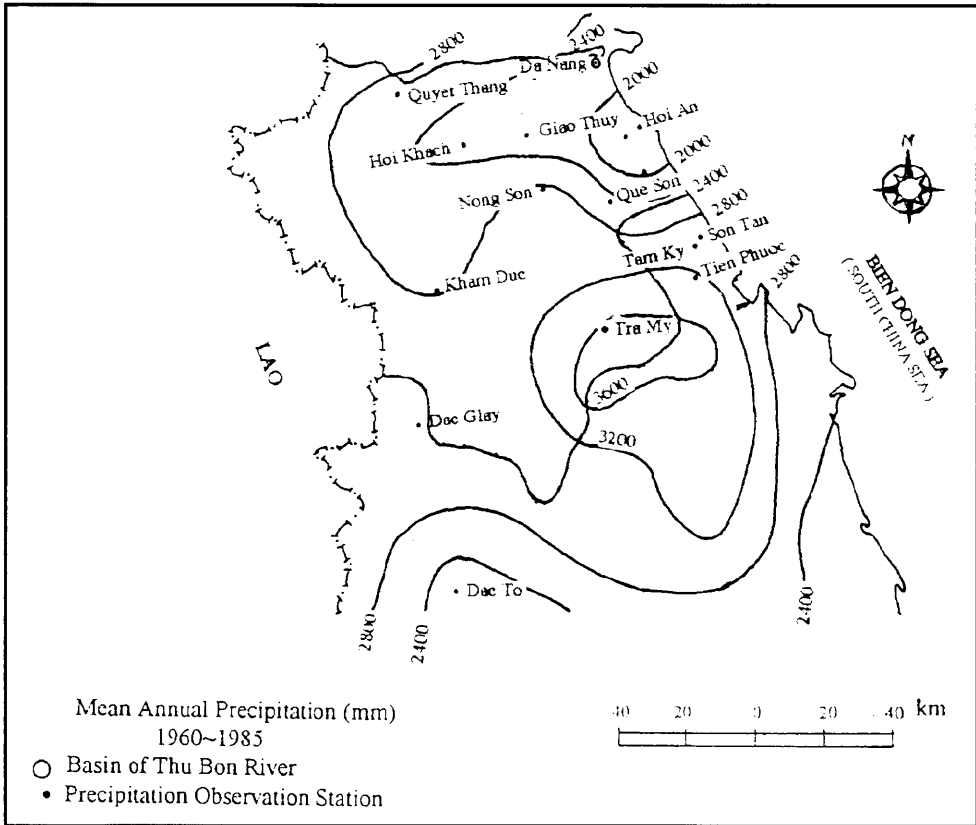
A: Other agricultural field F: Forest G: Grass P: Paddy field

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⁾ |
|-----|---------|---------------|-------------------------|------------------------|--------------------------------|------------------------------|---------------------------------|
| 211 | Da Nang | 6 | N 16° 02' E 108° 11' | (P) 1931~ (E) 1975~ | 2 002 | 1 093 | DS, E, P, SR |
| 212 | Tam Ky | - | N 15° 33' E 108° 30' | (P,E) 1979~ | 2 345 | 1 234 | DS, E, P |
| 213 | Tra My | - | N 15° 21' E 108° 13' | (P,E) 1977~ | 3 768 | 697.9 | DS, E, P |

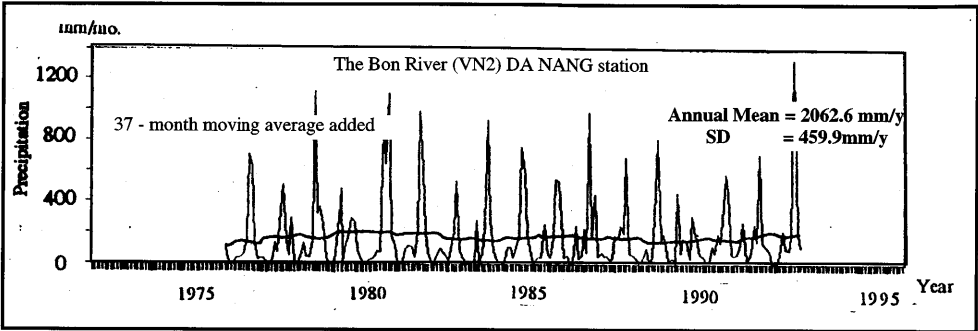
DS: Duration of sunshine observed by Helioscope
E: Evaporation observed by Piche tube

P: Precipitation observed by Pluviometer
SR: Solar radiation

3.3 Monthly Climate Data

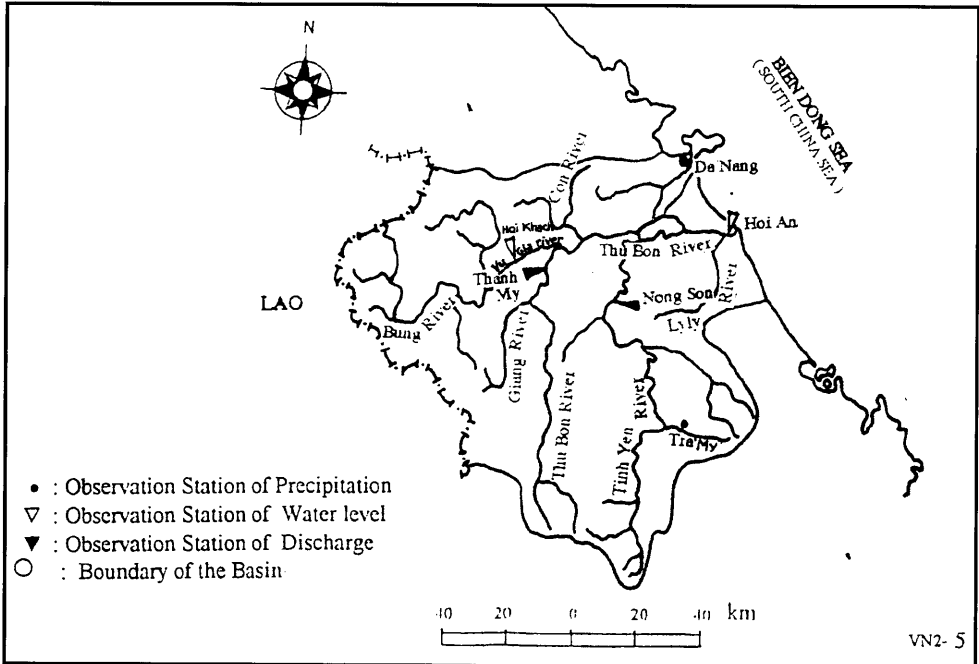
| Observation item | Observation station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Period for the mean |
|---|---------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|---------------------|
| Temperature [°C] | Da Nang | 21.3 | 22.4 | 24.1 | 26.2 | 28.2 | 29.2 | 29.1 | 28.7 | 27.3 | 25.7 | 24.0 | 21.9 | 25.7 | 1931~1990 |
| Precipitation [mm] | Da Nang | 92.6 | 33.9 | 22.0 | 26.0 | 74.6 | 84.8 | 88.8 | 106.5 | 336.0 | 610.0 | 363.7 | 198.1 | 2 002 | 1931~1990 |
| Evaporation [mm] | Da Nang | 70.5 | 68.3 | 82.6 | 91.1 | 110.9 | 119.2 | 129.6 | 118.5 | 89.7 | 76.7 | 70.3 | 65.7 | 1 093 | 1975~1990 |
| Solar radiation [Kcal/cm ²] | Da Nang | 7.5 | 8.6 | 11.3 | 12.7 | 11.4 | 13.0 | 14.6 | 12.9 | 10.8 | 8.6 | 6.3 | 5.4 | 123.1 | 1978~1990 |
| Duration of sunshine [hr] | Da Nang | 144.1 | 154.7 | 124.1 | 221.4 | 271.5 | 255.3 | 274.3 | 227.5 | 191.3 | 157.7 | 131.4 | 119.4 | 2 273 | 1958~1990 |

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



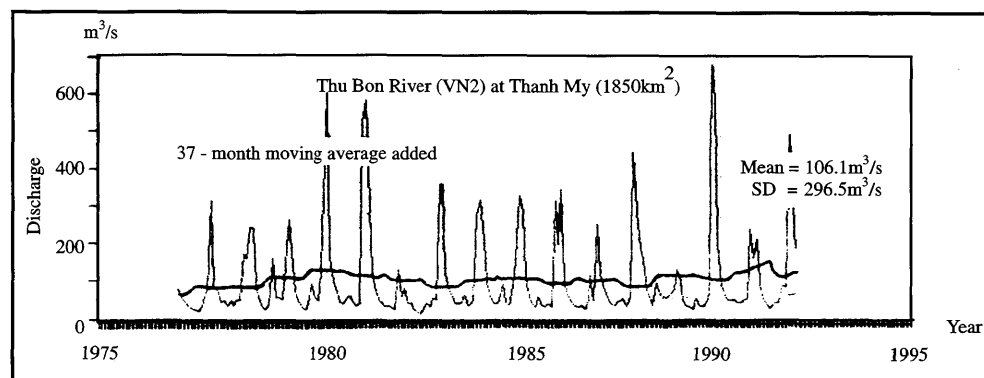
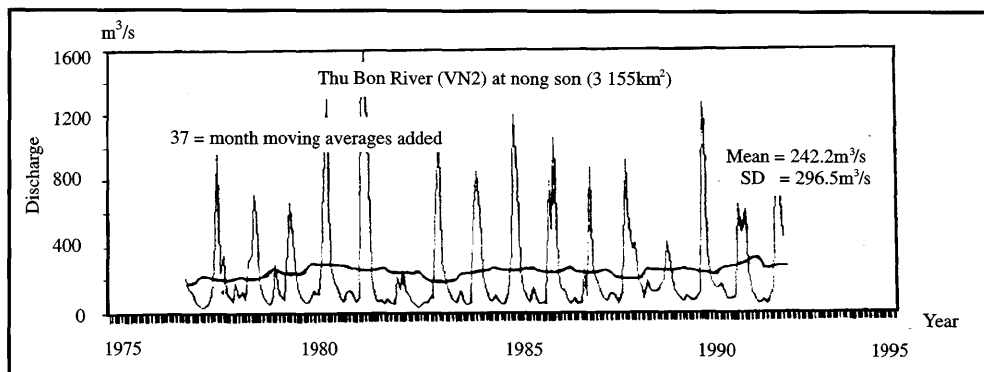
4.2 List of Hydrological Observation Stations

| No. | Station | Location | Catchment area (A) [km ²] | Observation period | Observation items ¹⁾ (frequency) |
|-----|----------|-------------------------|--|--------------------|--|
| 221 | Thanh My | N 15° 46' E 107° 50' | 1 850 | 1976~ | H, P, Q, S |
| 222 | Nong Son | N 15° 42' E 108° 03' | 3 155 | 1976~ | H, P, Q, S |

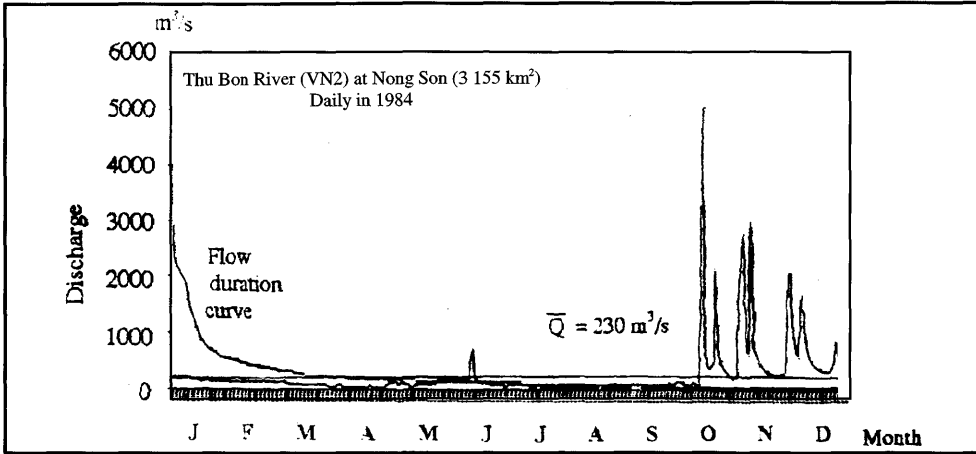
| No. | \bar{Q} ²⁾ [m ³ /s] | Q max ³⁾ [m ³ /s] | \bar{Q} max ⁴⁾ [m ³ /s] | \bar{Q} min ⁵⁾ [m ³ /s] | \bar{Q} / A [m ³ /s/100km ²] | Q max / A [m ³ /s/100km ²] | Period of statistics |
|-----|--|--|--|--|--|--|----------------------|
| 221 | 106.1 | 5 370 | 3 037 | 21.5 | 5.52 | 290 | 1977~1992 |
| 222 | 242.2 | 10 100 | 5 358 | 31.3 | 7.68 | 320 | 1977~1992 |

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

4.3 Long-term Variation of Monthly Discharge

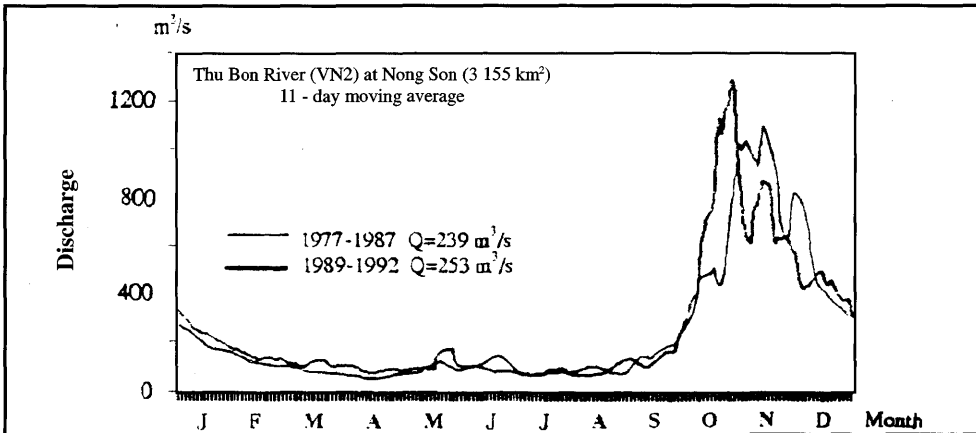


4.4 Annual Pattern of Discharge



4.5 Unique Hydrological Features

The annual discharge patterns before and after the construction of the Trung Loc Dam in 1988.



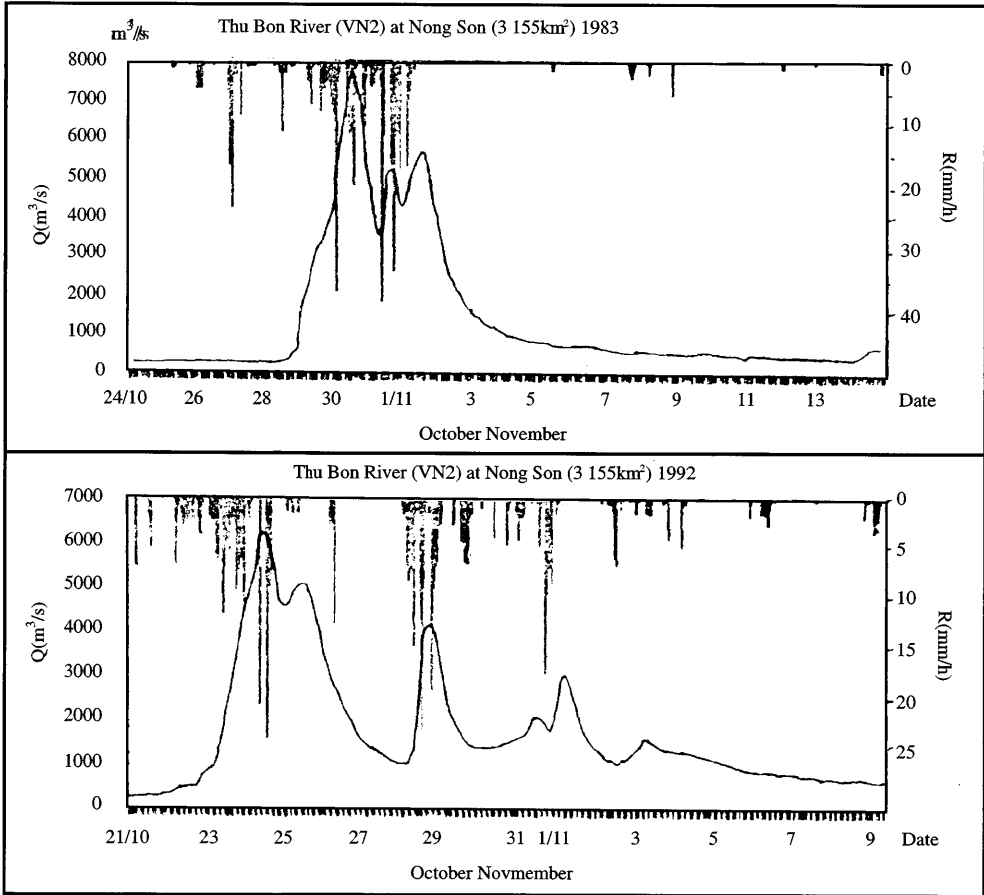
4.6 Annual Maximum and Minimum Discharges

At Nong Son [3 155 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] |
| 1977 | 11.04 | 4 050 | 8 | 14.6 | 1985 | 1.30 | 5 040 | 9 | 25.1 |
| 1978 | 11.04 | 3 060 | 4 | 53.5 | 1986 | 12.03 | 10 100 | 9 | 23.5 |
| 1979 | 10.15 | 3 470 | 4 | 36.7 | 1987 | 11.19 | 3 790 | 8 | 25.0 |
| 1980 | 11.17 | 6 820 | 5 | 36.4 | 1988 | 10.10 | 4 640 | 9 | 24.4 |
| 1981 | 10.14 | 5 730 | 9 | 29.9 | 1989 | 5.25 | 3 290 | 5 | 52.9 |
| 1982 | 9.07 | 2 800 | 8 | 25.6 | 1990 | 11.13 | 7 900 | 5 | 31.3 |
| 1983 | 10.30 | 7 660 | 6 | 20.6 | 1991 | 10.24 | 3 720 | 8 | 41.8 |
| 1984 | 10.13 | 7 440 | 9 | 29.4 | 1992 | 10.24 | 6 220 | 7 | 29.4 |

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

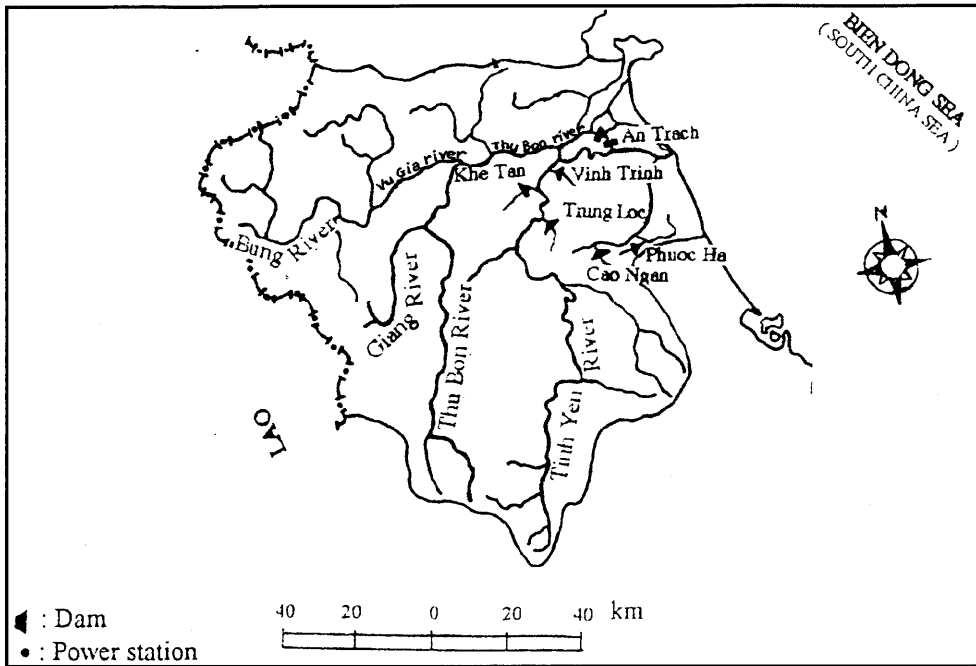
According to data collected up to 1985, the mean annual rainfall in the basin has been 2 673 mm or 29.0 km³ while the mean annual runoff is 1 915 mm or 20.0 km³. The surface component is 1 340 mm or 14.0 km³ and the ground water component is 575 mm or 6.0 km³. The mean annual evaporation from the basin is 848 mm or 8.9 km³ and the specific discharge is mostly over 0.060 m³/s/km². The coefficient of variation of annual runoff Cv has been in the range 0.17~0.20.

Flood runoff makes 65% of annual flow. The maximum flood discharge (by indirect investigation) in Thu Bon River at Hoi Khach was 27 000 m³/s in November 1964, and at Nong Son (3 155 km²) it was 18 200 m³/s in November 1964 and 10 100 m³/s in December 1986 (also by indirect investigation).

Low flow specific discharges are rather high varying between 0.018~0.042 m³/s/km². The minimum discharges at Hoi Khach and at Nong Son have been 40 m³/s and 14.6 m³/s respectively in 1977.

In recent years some reservoirs (Con dam, Khe Tan reservoir) have been built: The latter irrigates an area of 3 250 ha .

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 |
|---------------|-------------|-----------------------------------|--|--|------------|--------------------|
| Thu Bon | An Trach | - | - | - | A, F, I, W | 1940 |
| | Khe Tan | 88.0 | 54.10 | 46.50 | A | 1986 |
| | Trung Loc | 2.6 | 1.56 | 1.41 | A | 1988 |
| | Cao Ngan | 8.0 | 4.06 | 3.56 | A | 1976 |
| | Phuoc Ha | 12.4 | 4.80 | 4.10 | A | 1979 |
| | Vinh Trinh | 29.2 | 21.80 | 20.80 | A | 1979 |

A: Agricultural use; F: Flood control; I: Industrial use; W: Municipal water supply

The An Trach system includes 4 dams built in 1940 for water regulation and distribution to downstream structures and pumping stations. Reservoirs in Thu Bon River were built mostly for irrigation, and in some areas for domestic and industrial use and environmental improvement.

5.4 Major Flood and Droughts

Major Flood at Nong Son [3 155 km²]

| Date | Peak discharge [m ³ /s] | Rainfall [mm] Duration | Meteorological cause | Dead and missing | Major damages (Districts affected) |
|---------------------|---------------------------------------|-----------------------------------|-------------------------|---------------------|---------------------------------------|
| 1980 11.13~11.30 | 6 820 | 785.3 11.09~11.21 | Typhoon | | Que Son Town |
| 1981 10.10~10.20 | 5 730 | 515.2 10.09~10.11,10.13~10.15 | Typhoon | | Que Son Town |
| 1983 10.27~11.13 | 7 660 | 899.3 10.26~11.02 | Typhoon | | Que Son Town |
| 1984 10.12~10.17 | 7 440 | 576.8 10.12~10.22 | Typhoon | | Que Son Town |
| 1985 11.24~12.10 | 5 040 | 555.3 11.24~12.04 | Typhoon | | Que Son Town |
| 1986 11.30~12.18 | 10 100 | 410.0 11.30~12.06 | Typhoon | | Que Son Town |
| 1990 11.09~11.20 | 7 900 | 311.1 11.09~11.16 | Typhoon | | Que Son Town |
| 1992 10.20~11.18 | 6 220 | 899.8 10.20~10.26, 10.28~11.04 | Typhoon | | Que Son Town |

5.5 Groundwater and Water Quality

Groundwater is abundant in sedimentary, unconsolidated formations with quality suitable for domestic use. No data about ground water withdrawals are available.

6. Socio-cultural Characteristics

The socio-economic developments are very active in the coastal areas of the basin, especially in Da Nang and Hoi An cities where some industrial factories have been established. Da Nang is the largest city and port in central Vietnam and Hoi An is an old township with specific cultural structures famous not only in Vietnam but in the region as well.

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

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