

Nam Sekong

Map of River



Table of Basic Data

| | | |
|---|---|---------------------|
| Name(s): Sekong | | Serial No. : Lao-9 |
| Location: South-east Lao PDR | E 106° 16' - 107° 29' | N 14° 41' - 16° 20' |
| Area: 10,500 km ² | Length of the main stream: 170 km (Attapu) | |
| Origin: Lao-Vietnam border 1,800 m | Highest Pt: Ban Tane, 2,066 m | |
| Outlet: ATTAPU, Muang Mai | Lowest Pt: Attapu, 106 m | |
| Main base rock: Mesozoic to Paleozoic, Sandstones and volcanic rock | | |
| Main tributaries: Xenam Noy, 1,501 km ² | | |
| Main Lakes: None. | Main Reservoir: None | |
| Mean Annual Precipitation: 2,149 mm (1988-2000) | Mean annual Runoff: 512 m ³ /s at Attapu (1988-2000) | |
| Population: 87,700 (Census 1996) | Main Cities: ATTAPU, Muang Sekone | |
| Land use: Forest 61%, Agriculture 20% | Others 10%; Water resources 9% (1996) | |

1. General Description

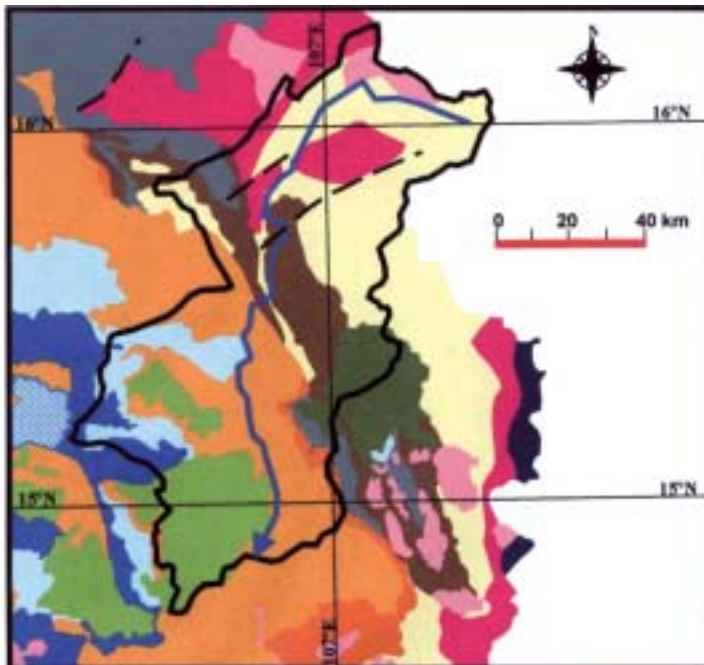
In Lao, Se or Nam means River, while Kong is a drum played in a pagoda or Wat. The origin of the name Sekong comes from the Jadis, the people who live in the remote source area of the river. Legend has it that the Jadis had to leave their village to go to Attapu. Whilst crossing the river they lost the big drum of the pagoda into the river, probably in a flash flood. Since that time the river has been named “Sekong”.

The source of the river is near the Lao-Vietnam border at an elevation of 1,800 m. The length of the main stream to Attapu is about 170 km. The highest point in the basin, near Ban Tang, is 2,066 m, whilst the lowest point, 106 m, is at Attapu. The total catchment at Attapu is 10,500 km² just above where the Sekamane River (catchment area of 4,454 km² at Ban Fang Deng about 15 km east of Attapu town) joins the Sekong. The Sekamane River joins the Sekong downstream of the Muang Mai gauging station and can cause a backwater effect on the Sekong during floods.

The basin is composed of 42.1% sandstone and conglomerate, 29.4% gneiss, schist, quartzite, granite, and gable, 13.9% basalt, 8.8% shale and only 3.3% sandy alluvium. The climate is tropical humid and despite the basin having a high forest coverage (54-67%), there have been important trends in the variation of rainfall. For example, at Attapu the averages over groups of years have varied between 2,534 mm/y (1900-1910), 2,203 mm/y (1913-1921), 2,814 mm/y (1929-1941), and 2,149 mm/y (1988-2000). At Sekong only 1,493 mm/y fell from 1988 to 2000. It is generally considered that deforestation by nomadic people in the basin has had a direct effect on the natural environment causing an increase of the surface runoff and water velocity so that the natural flood mitigation of the forest has been reduced. In recent years natural disasters resulting from climatic abnormalities have caused more frequent floods and droughts, with the 1996 flood being the most severe at Attapu.

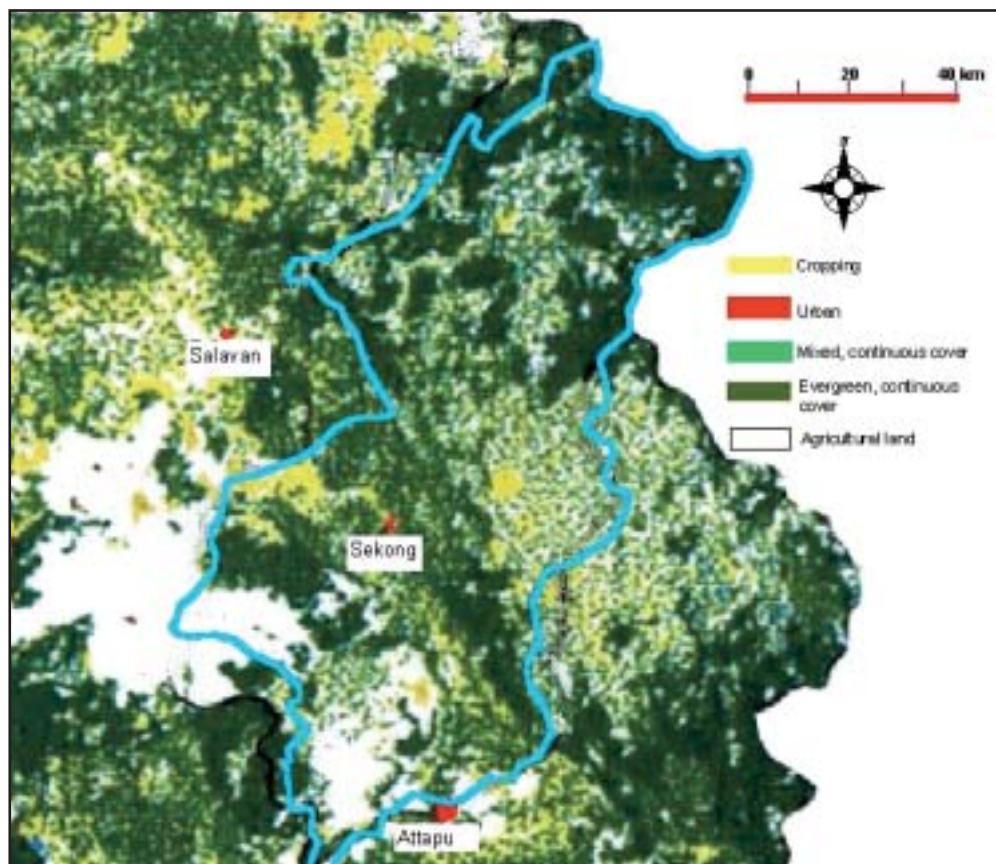
2. Geographical Information

2.1 Geological Map



| | | | | | | | | | | | | | | | | | | | | | | |
|------------|-----|---|-----------|------------|-----------|-----------------|--|-----------|---------------|-----------------|-----------------|--|---|---|---------------|------------|-----------------|---|--|-------------|----|--|
| QUATERNARY | vQ | Unconsolidated gravels, sand, silts, and clays mostly of fluvial origin with some basaltic lava flows (v), ash and loess. Laterfitted intra-sequence erosion surfaces are present | TERTIARY | Neogene | 2 | vN | Alkal basalt lava flows (v) (basanitoid types) with associated eruptive vents. | PALAEZOIC | Carboniferous | 1 | rP ₁ | Mostly shallow sea sequence of muddy limestone (c). Some continental Carboniferous in Vientiane basin, Salavan (S Central) and Phongsav (N). | | | | | | | | | | |
| | | | | | 1 | | | | | | | | | | | | | | | | | |
| MESOZOIC | vPg | Mostly red continental sandstones and clays, with lagoonal mudrocks in the upper levels bearing evaporite units of halite and gypsum. | Paleogene | Cretaceous | 3 | vP _g | Aikal basalt lava flows (v) (basanitoid types) with associated eruptive vents. | PALAEZOIC | Devonian | 3 | P ₂ | Mostly marine volcanosedimentary sequences with mudrocks, wackes, arenites, silicic and intermediate volcanic rocks lightly metamorphosed | | | | | | | | | | |
| | | | | | 2 | | | | | | | | | | | | | | | | | |
| | | | | | 1 | | | | | | | | | | | | | | | | | |
| | | | | | Jurassic | | | | | 3 | | | vP ₂ | Mostly continental sequence with local water marine facies persisting from Upper Palaeozoic. Continental red clayey arenites with occasional thin coal seams and conglomerates. Middle Triassic marine limestone units occur at the base of this interval interbedded with clays in NE and NW Marine Liassic in SE. | PALAEZOIC | Silurian | 2 | P ₁ | Deep water volcanosedimentary sequence, metamorphosed to low or low-medium grades in the E. Mudrocks, wackes, sericite schists and arenites, amphibolite, black limestone, mafic intermediate and silicic volcanic rocks | | | |
| | | | | | | | | | | 2 | | | | | | | | | | | | |
| | | | | | | | | | | 1 | | | | | | | | | | | | |
| | | | | | Triassic | | | | | 3 | | | vP ₁ | Shallow shelf sea sequence interdigitated with a volcanosedimentary sequence. Mostly sandstone, siltstone, and shale in the N and NW. | PALAEZOIC | Ordovician | 3 | P ₁ | Scattered outcrop areas of low to high grade metamorphic rocks close to the NE and SE borders with Vietnam. | | | |
| | | | | | | | | | | 2 | | | | | | | | | | | | |
| | | | | | PALAEZOIC | | | | | vP ₁ | | | Some silicic, intermediate and mafic extrusive rocks (v) 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. Epiepiclastic rocks predominate over limestone in the W and S. | Permian | Carboniferous | 2 | vP ₁ | Some silicic, intermediate and mafic extrusive rocks (v) 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. Epiepiclastic rocks predominate over limestone in the W and S. | PRECAMBRIAN | Proterozoic | PR | Song Ma (NE) – Low-grade mica-schists, quartz chlorite-sericite schists and arenites, and marbles. This sequence may continue upwards into the Lower Palaeozoic. Ultramafic rocks (u) occur in narrow belts. Kantou Massif (SE) – Medium to high grade metamorphic rocks: granuloid gneiss, mica schist (with garnet, cordierite kyanite or sillimanite), amphibolite and marble. |
| | | | | | | | | | | | | | | | | 1 | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | |

2.2 Land Use Map

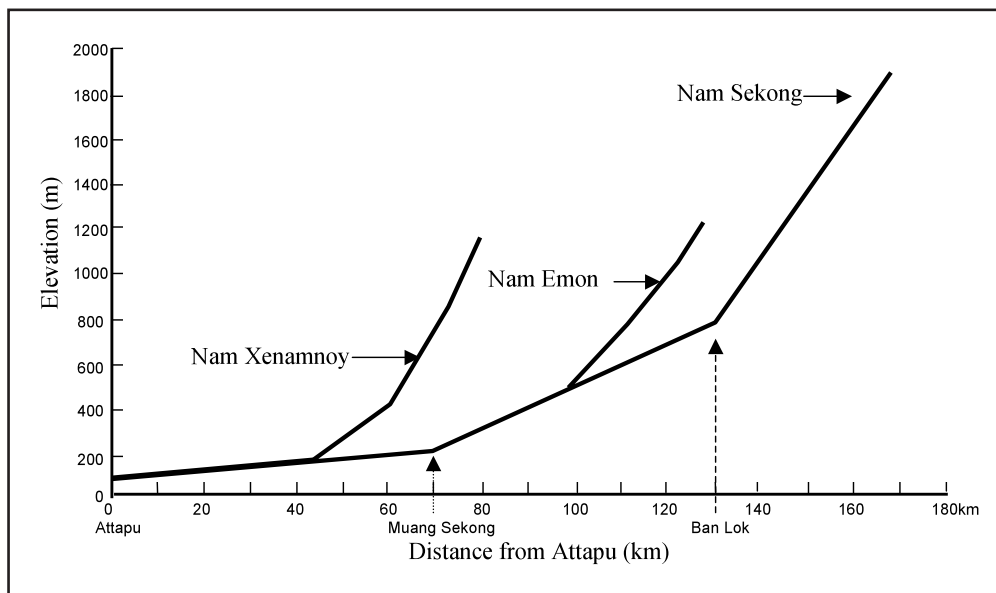


2.3 Characteristics of the River and the Main Tributaries.

| No. | Name of river | Length [km] Catchment area [km ²] | Highest peak [m] Lowest point [m] | Cities Population (year) | Land use [%] |
|-----|---------------|--|--------------------------------------|-----------------------------|--------------------------------------|
| 1 | Sekong | 170 10,500 | 2,066 106 | Sekong (Lamam) 20,000 | F (54) A (10) U (2) O (31) |
| 2 | | | | Attapu 50,000 | F (66) A (15) U (5) O (141) |

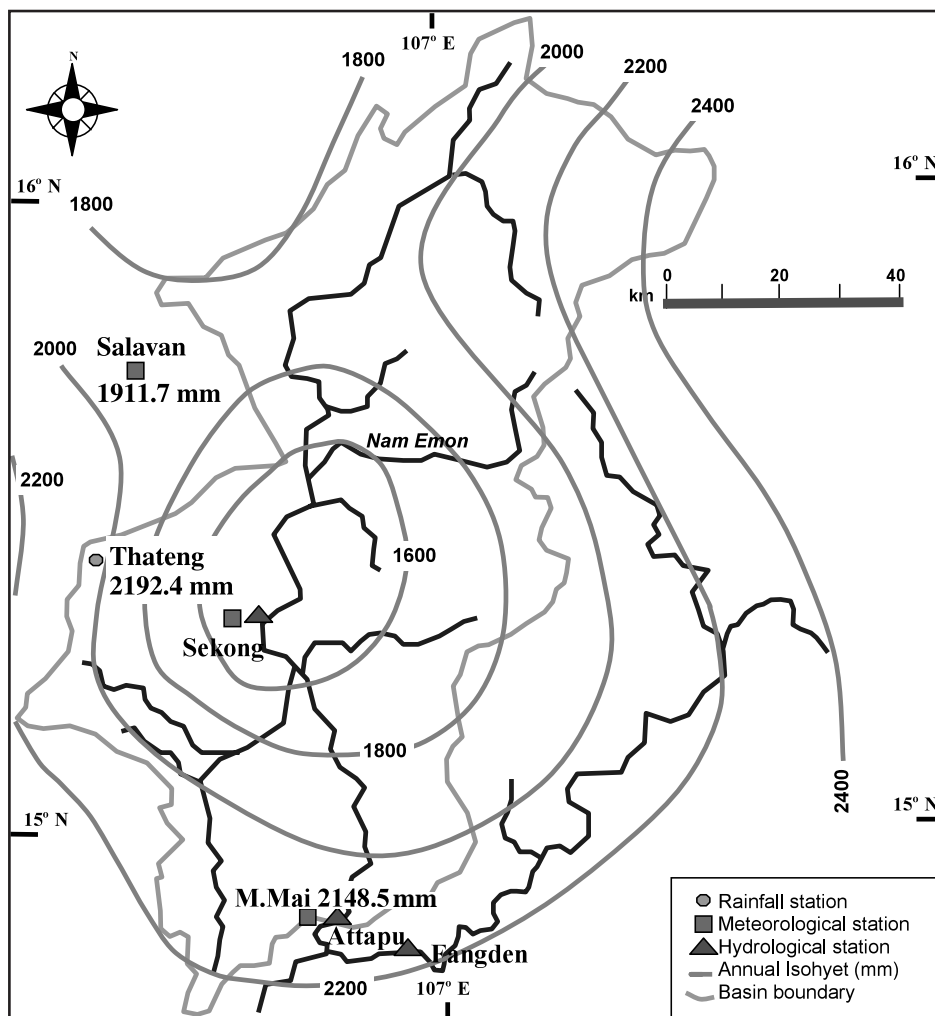
F: Forest; L: Lake, river, marsh; P: Paddy field; U: Urban
O: Orchard; A: Agricultural field (vegetable field, grass field)

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyetal Map and Observation Stations



3.2 List of Meteorological Observation Stations

| Number | Station | Elevation [m] | Location | Observation period | Mean annual Precipitation [mm] | Mean annual evaporation [mm] | Observation Items* |
|--------|-------------|---------------|-------------------------|--------------------|--------------------------------|------------------------------|--------------------|
| 1 | Sekong Town | 144 | N 15° 26' E 106° 44' | 1989 - 2000 | 1,493 | 1,506 | P, E, T, WV |
| 2 | Thateng | 800 | N 15° 28' E 106° 22' | 1929 - 1998 | 2,192 | - | P |
| 3 | Attapu | 106 | N 14° 48' E 106° 50' | 1988 - 2000 | 2,149 | Pich + 1.5 1,469 | P, E, DS, T, WV |

* P: Precipitation E: Evaporation DS: Duration of sunshine WV: Wind velocity T: Temperature

3.3 Monthly Climate Data

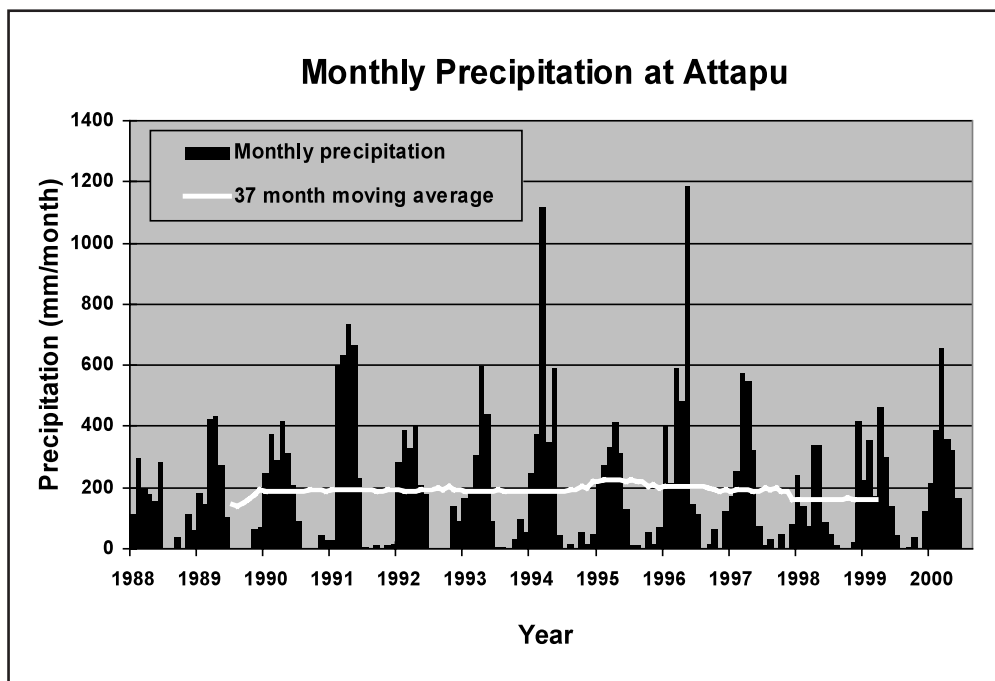
Station: Sekong (Lamam)

| Observation station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Period for mean |
|----------------------|------|------|------|------|-------|-------|-------|-------|-------|-------|------|------|--------|-----------------|
| Temperature [°C] | 24.2 | 26.2 | 28.3 | 288 | 28.5 | 28.1 | 27.2 | 27.3 | 27.3 | 26.8 | 25.6 | 24.0 | 26.9 | 1995 - 2000 |
| Precipitation [mm] | 2.7 | 16.0 | 43.7 | 80.5 | 151.9 | 207.4 | 289.0 | 286.1 | 281.1 | 107.0 | 24.2 | 3.3 | 1,493 | 1989 - 2000 |
| Evaporation PET [mm] | 128 | 140 | 173 | 149 | 144 | 127 | 158 | 100 | 93 | 93 | 89 | 111 | 1,506 | 1995 - 2000 |

Station: Attapu

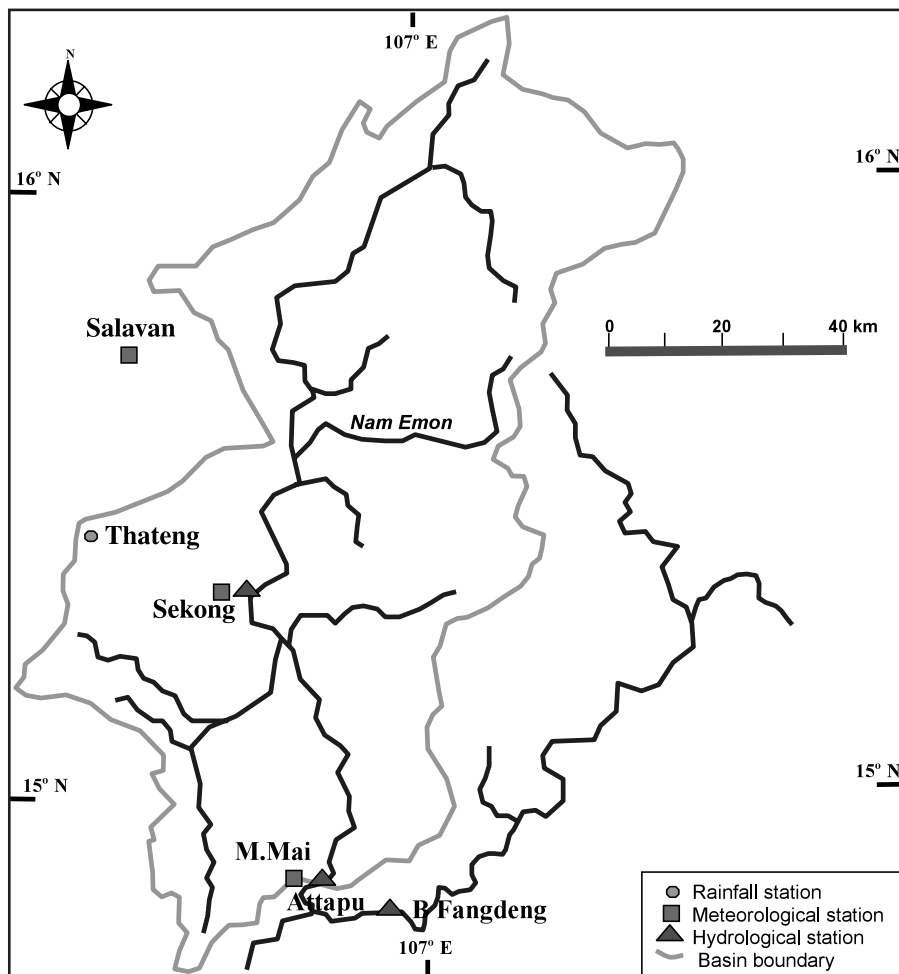
| Observation station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Period for mean |
|----------------------|------|------|------|------|-------|-------|-------|-------|-------|-------|------|------|--------|-----------------|
| Temperature [°C] | 25.2 | 27.0 | 29.4 | 30.3 | 29.3 | 28.7 | 27.3 | 27.3 | 27.4 | 27.1 | 26.4 | 25.3 | 27.5 | 1989 - 2000 |
| Precipitation [mm] | 6.2 | 24.0 | 43.9 | 97.6 | 211.0 | 306.9 | 438.4 | 440.1 | 417.9 | 144.6 | 25.7 | 5.9 | 248.9 | 1988 - 2000 |
| Evaporation PET [mm] | 105 | 116 | 132 | 98 | 80 | 53 | 48 | 46 | 41 | 57 | 84 | 120 | 980 | 1989 - 2000 |
| Sunshine [hours] | 277 | 256 | 263 | 213 | 184 | 167 | 149 | 156 | 128 | 189 | 89 | 242 | 2,442 | 1989 - 2000 |

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



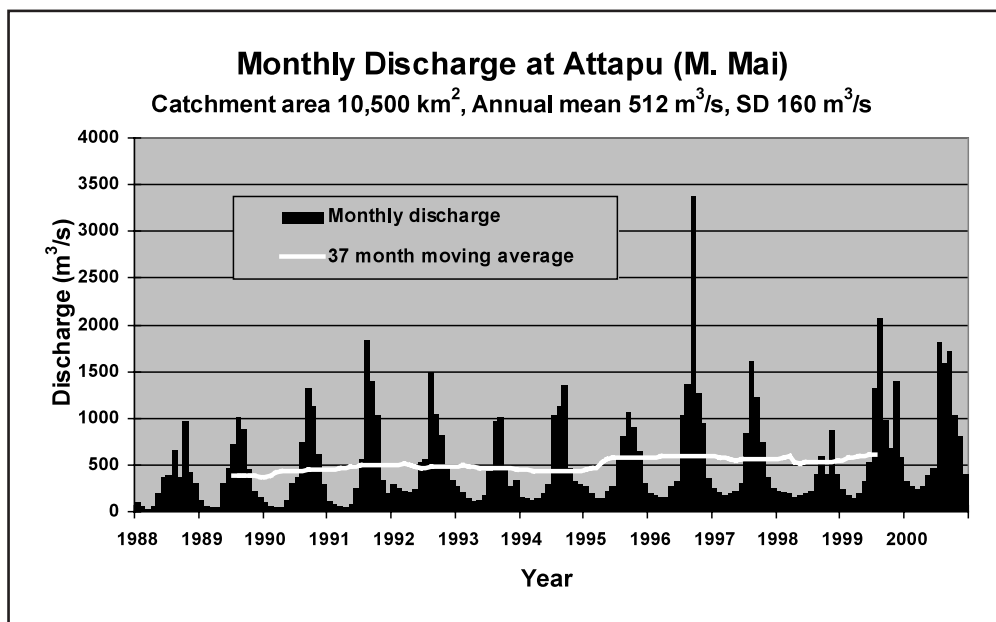
4.2 List of Hydrological Observation Stations

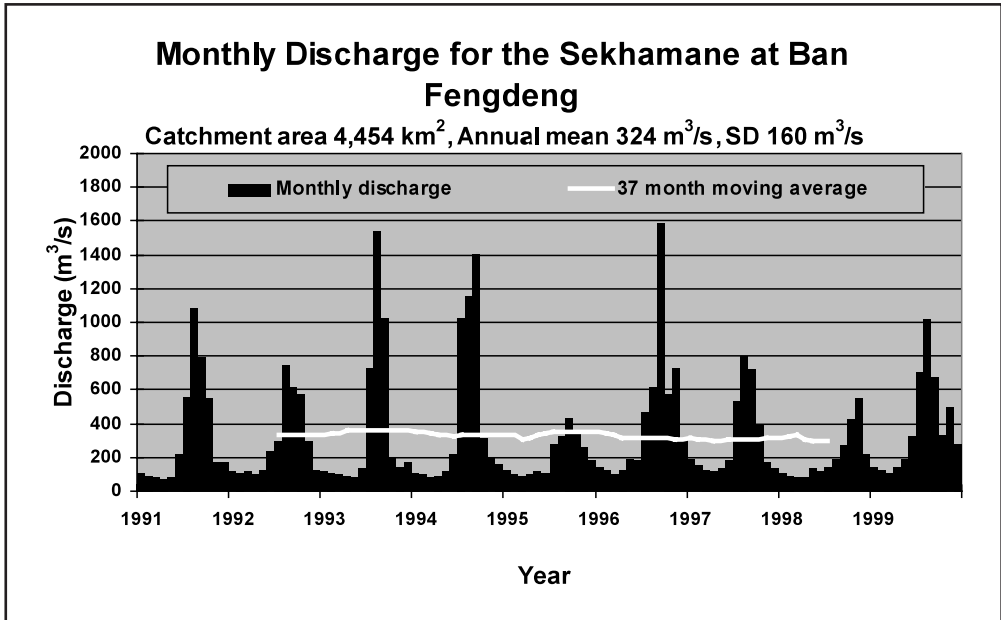
| No. | Station | Location | Elevation [m] | Catchment area (A) [km ²] | Observation period | Observation items ^a (frequency) |
|-----|-----------------------|-------------------------|---------------|---------------------------------------|--------------------|--|
| 1 | Lamam (Sekong) | N 15° 26' E 106° 50' | 135 | - | 1990 - 2000 | H2 daily |
| 2 | M. Mai (Attapu) | N 14° 48' E 102° 40' | 106 | 10,500 | 1988 - 2000 | H2, Q daily |
| 3 | Sekamane (B. Fangden) | N 14° 48' E 106° 55' | 106 | 4,454 | 1991 - 1999 | H2, Q daily |

| No. | Q ^b [m ³ /s] | Qmax ^c [m ³ /s] | Qmax ^d [m ³ /s] | Qmin ^e [m ³ /s] | Q/A [m ³ /s/100km ²] | Qmax ^c /A [m ³ /s/100km ²] | period of statistics |
|-----|------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---|--|----------------------|
| 2 | 512.1 | 13,878 | 5,852 | 118.7 | 4.88 | 132.2 | 1988 - 2000 |
| 3 | 324.1 | 5,235 | 3,076 | 81.4 | 7.28 | 117.5 | 1991 - 2000 |

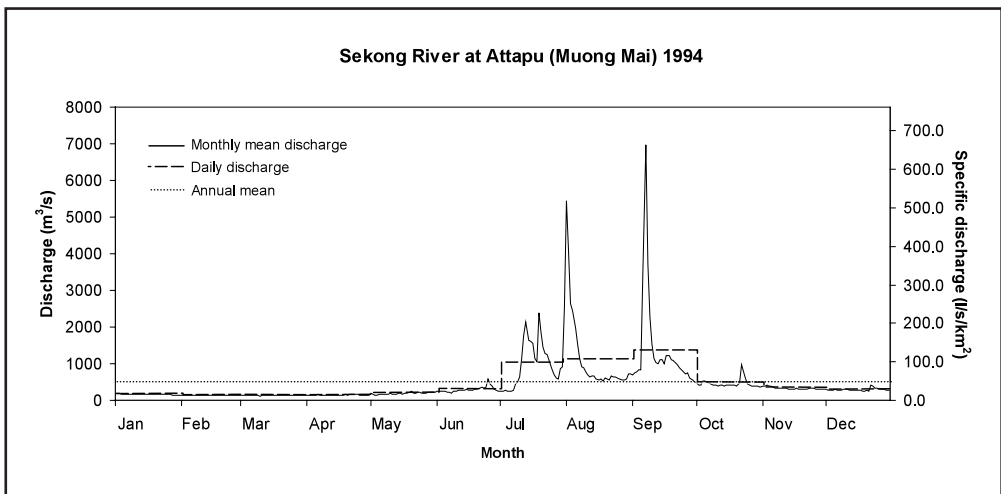
^a H2: manual water level, Q: discharge ^b mean annual discharge ^c maximum discharge ^d mean annual maximum discharge
^e mean annual minimum discharge

4.3 Long-term Variation of Monthly Discharge

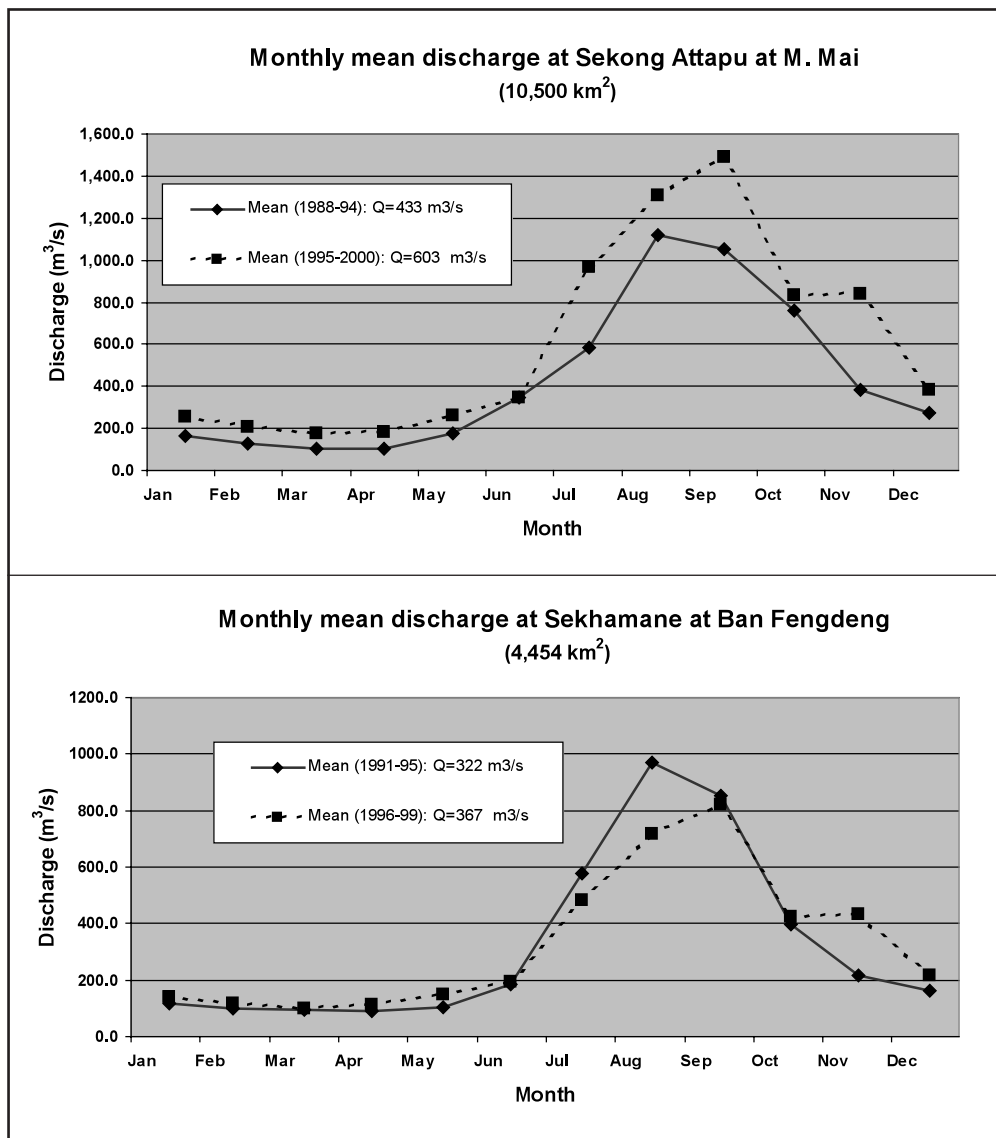




4.4 Annual Pattern of Discharge



4.5 Unique Hydrological Features



4.6 Annual Maximum and Minimum Discharges

a) Nam Sekong at Attapu (M. Mai), Catchment area = 10,500 km²

| Year | Maximum | | Minimum | |
|--------|-------------------|--|---------|--|
| | Date ^a | Discharge ^b [m ³ /s] | Month | Discharge ^c [m ³ /s] |
| 1987 | 8.23 | 5,700 | X | X |
| 1988 | 10.17 | 4,640 | 5 | 157.8 |
| 1989 | 7.24 | 4,750 | 4 | 40.0 |
| 1990 | 9.20 | 5,710 | 4 | 36.7 |
| 1991 | 8.17 | 5,040 | 4 | 44.0 |
| 1992 | 8.28 | 2,320 | 4 | 165.0 |
| 1993 | 9.9 | 3,390 | 4 | 87.8 |
| 1994 | 9.7 | 7,848 | 3 | 125.0 |
| 1995 | 7.31 | 2,798 | 4 | 126.6 |
| 1996 | 9.20 | 13,878 | 4 | 138.0 |
| 1997 | 9.26 | 7,163 | 4 | 151.2 |
| 1998 | 11.21 | 4,108 | 5 | 120.1 |
| 1999 | 8.4 | 5,678 | 4 | 141.5 |
| 2000 | 8.24 | 8,905 | 4 | 209.0 |
| Sum = | | 81,928 | | 1,542.7 |
| Mean = | | 5,852 | | 118.7 |

b) Nam Sekhamane at Attapu (B. Fengdeng), Catchment area = 4,454 km²

| Year | Maximum | | Minimum | |
|--------|-------------------|--|---------|--|
| | Date ^a | Discharge ^b [m ³ /s] | Month | Discharge ^b [m ³ /s] |
| 1991 | 8.19 | 3,365 | 4 | 70.6 |
| 1992 | 10.25 | 1,500 | 5 | 77.8 |
| 1993 | 9.7 | 2,438 | 5 | 70.6 |
| 1994 | 9.6 | 4,135 | 3 | 79.7 |
| 1995 | 7.31 | 1,356 | 3 | 83.4 |
| 1996 | 9.19 | 5,235 | 3 | 89.2 |
| 1997 | 9.26 | 3,767 | 4 | 103.1 |
| 1998 | 11.21 | 2,959 | 3 | 70.6 |
| 1999 | 8.3 | 2,933 | 3 | 87.2 |
| Sum = | | 27,688 | | 732.2 |
| Mean = | | 3,076 | | 81.4 |

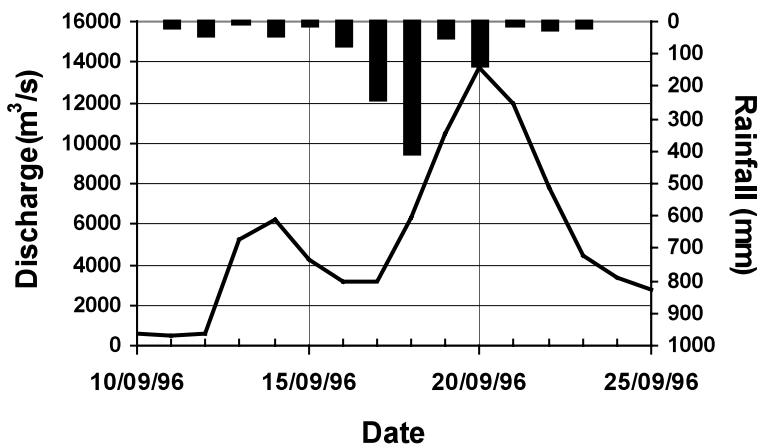
^a date in form month. day

^b 2 readings per day

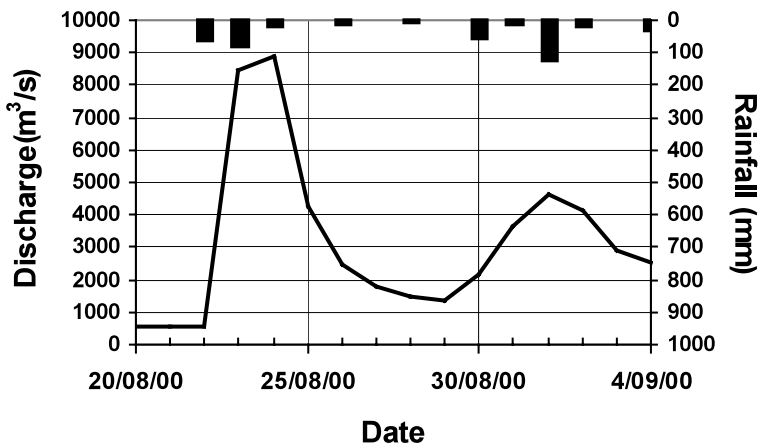
^c daily reading

4.7 Hyetographs and Hydrographs of Major Floods

Flood on Sekong River at Attapu (September 1996)



Flood on Sekong River at Attapu (August-September 2000)



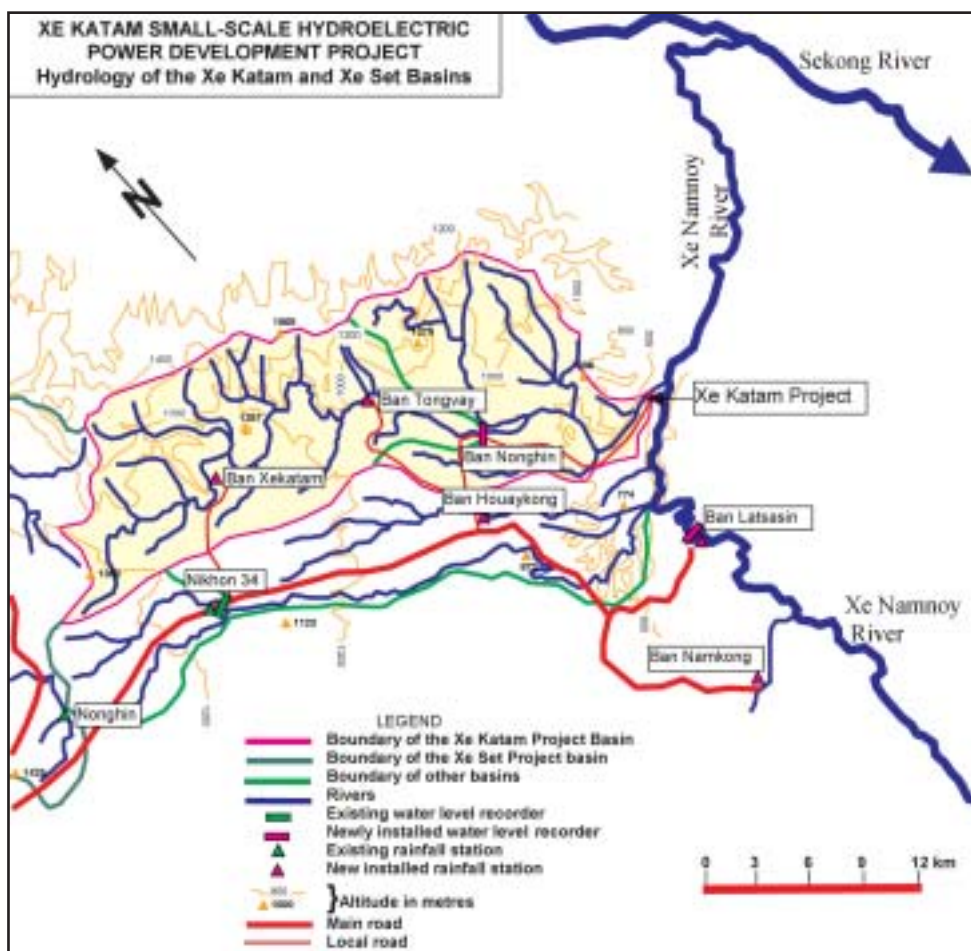
5. Water Resources

5.1 General Description

In the Sekong basin there are several promising projects for different sized hydropower developments. As hydropower has a prominent place in the national policy, the government of the Lao PDR has recognized the strategic value of the hydropower sector and its competitive advantage over other indigenous energy sources in the region. According to the study conducted by the Mekong Committee, there are 5 sites in the Sekong, and 4 sites in Sekhamane and Xenamnoy with a potential total installed capacity of 3,130 MW and annual energy production of about 15,613 GW/h. A study of the Xenamnoy, and Houay KaTakTok by JICA identified sites with a potential installed capacity of 354 MW and annual energy production of 1,042.4 GW/h.

In the 290 km² Xe Katam basin (a river that flows in a south-easterly direction from an elevation of 300 m - see map), accurate hydro-meteorological data were collected and used in a Tank Model simulation. Ten years of data were collected (1980-1990) for this study. A Memorandum of Understanding has been signed for a scheme with a potential capacity of 100 MW (Source: Hydropower, Office of the Ministry of Industry and Handicrafts).

5.2 Map of Water Resource Systems



5.4 Major Floods and Droughts

| Date | Peak discharge [m ³ /s] | Rainfall [mm] | Meteorological Cause | Damages at Attapu |
|---------------------|------------------------------------|-------------------------|----------------------|---------------------------------|
| 1996 9.16 - 9.21 | 13,687 | 920.5 mm over 6 days | Typhoon | 5 deaths Rice fields flooded |
| 2000 8.22 - 8.24 | 8,905 | 162.8 mm over 3 days | Typhoon | Rice fields flooded |

Remark: An historic flood caused by a typhoon flash flood at Attapu M. Mai was reported in September 1930 and caused damage to properties and crops.

Droughts mostly occur during ENSO events and cause severe damage to rice production.

6. Socio-cultural Characteristics

Most people of the Sekong basin live by subsistence agriculture, with a small amount of cash crop production. Pools on the margins of river and in seasonal wetlands are used for agriculture, buffalo grazing and for mammal and waterbird hunting. This is likely to have serious impacts on the small but very important populations of Giant Ibis, White-shouldered Ibis, Lesser Adjutant and Woolly-necked storks that feed in these habitats. In the upper Xenamnoy tributary of the Sekong there are freshwater marshes, lakes, and ponds with about 6 km² covered by wetland. The largest is the Nonglom, which appears to be the result of damming of the valley, possibly by a basalt flow. There is a local legend that a village formerly stood in what is now the middle of the Nonglom. One night springs are reported to have broken through under the village and flooded it and the valley, giving rise to the Nonglom. Villagers from far and near come to fish for Pakoh (*channa striata*), Padouk (*clarias* sp), Pakeng (*anabas testiduneus*), shrimp and occasionally tortoises. Fishing equipment is mainly gill nests, cast nets, and set lines. Hand-baskets are used in shallow waters. The Xenamnoy wetlands are under study. Outside of the Sekong there is a small wetland of 1 km² in the upper Sekhamane and a larger one of about 350 km², southwest of Attapu and forming the border between the Lao PDR and Cambodia.

7. References, Databooks and Bibliography

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