

Bailongjiang

Map of River

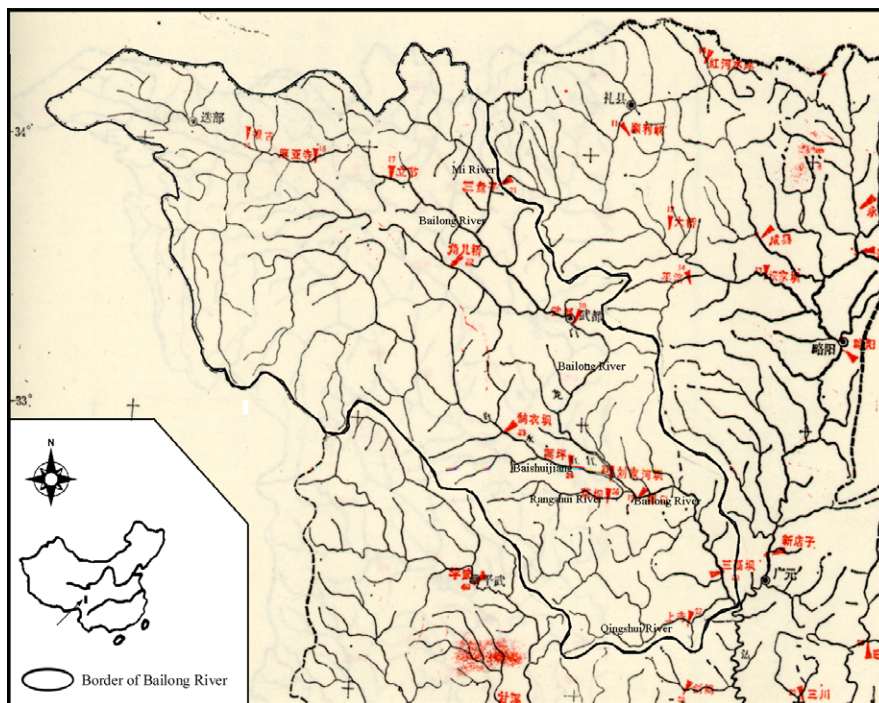


Table of Basic Data

Name(s): Bailongjiang		Serial No. : China-7
Location: Gansu Province, North-western China	N 32°30' ~ 34°30'	E 102° ~ 106°
Area: 31 808 km ²	Length of the main stream: 576 km	
Origin: Minshan 5 000 (m)	Highest point : Wugongshan 4 288 (m)	
Outlet: Jialingjiang	Lowest point : River mouth 16 (m)	
Main geological features : Carbonate rock, Metamorphic rock, Clastic rock		
Main tributaries: Baishuijiang (8 134 km ²), Qingshuihehe (3 150 km ²), Minhe (1 449 km ²), Rangshige (782 km ²)		
Main lakes: None		
Main reservoirs: Bikou (521 ×10 ⁶ m ³ , 1976), Baozhusi (2 451 × 10 ⁶ m ³ , 1996)		
Mean annual precipitation : 675 mm (1954~1979) (basin average)		
Mean annual runoff: 335 m ³ /s at Sanleiba(29 247 km ²) (1954 ~1995)		
Population: 2 555 700 (1990)	Main cities: Duwu, Wenxian, Diechang, Nanping	
Land use: Forest (39 %), Rice paddy (0.1%), Other agriculture (41%), Water surface(0.4 %), Urban (20 %) (1989)		

1. General Description

Bailongjiang, flowing in the general direction of northwest to southeast, is one of the main tributaries of the upper stream of Jialing Jiang in the Yangtze River Basin. Originating from the Min and Xiqing mountains, it borders the Ganshu, Sichuan and Shanxi provinces. The river, which is 576 km long, and has a catchment area of 31 800 km², passes through Diebu, Zhouqu, Wudu, Wenxian, and Guangyuan counties before joining the Jialingjiang. The coverage of forests in the basin is about 40 % of the total area. The area of the upper stream belongs to the Tibet Plateau, where the average elevation is 3 500 m. The lower stream is near the border of the Sichuan basin. There is a significant decrease in the elevation from the upper stream to the lower stream – from 2 500 m to 1 500 m.

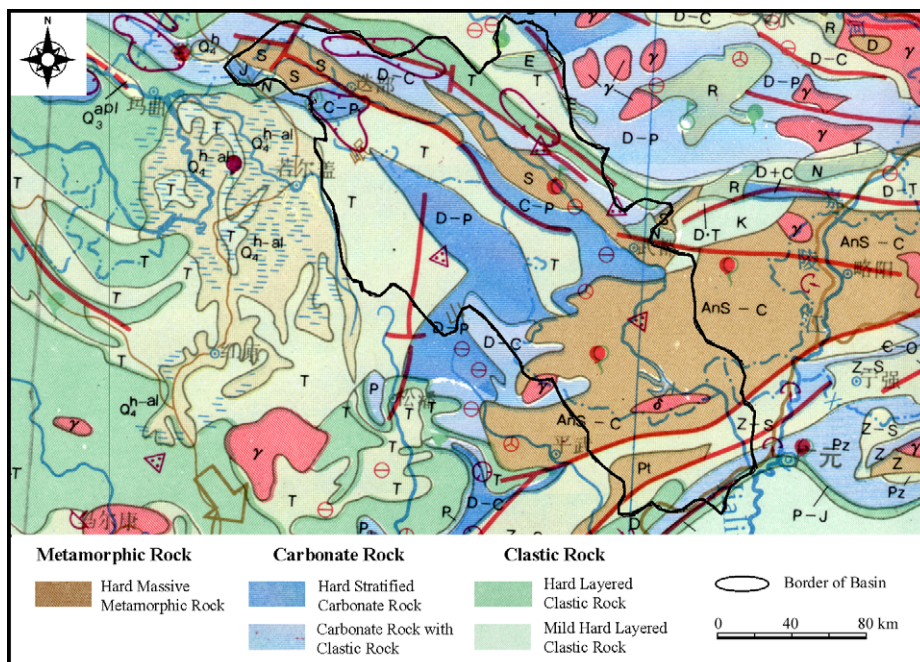
Due to geographical influence, the annual precipitation for the catchment varies along the main stream. The average annual precipitation for the upper stream is about 400~600 mm. However, it is only 450 mm in the middle stream. In the lower stream, it can reach 800~1 100 mm. Approximately 66.4 % of the annual precipitation in the basin is concentrated in the period from June~September. The mean annual discharge at Sanleiba station is 335 m³/s.

There are two large cascade reservoirs, namely, Bikou and Baozhushi, located in the middle and lower streams of Bailongjiang. The floods, caused by storms in summer, are mainly experienced in the lower stream area.

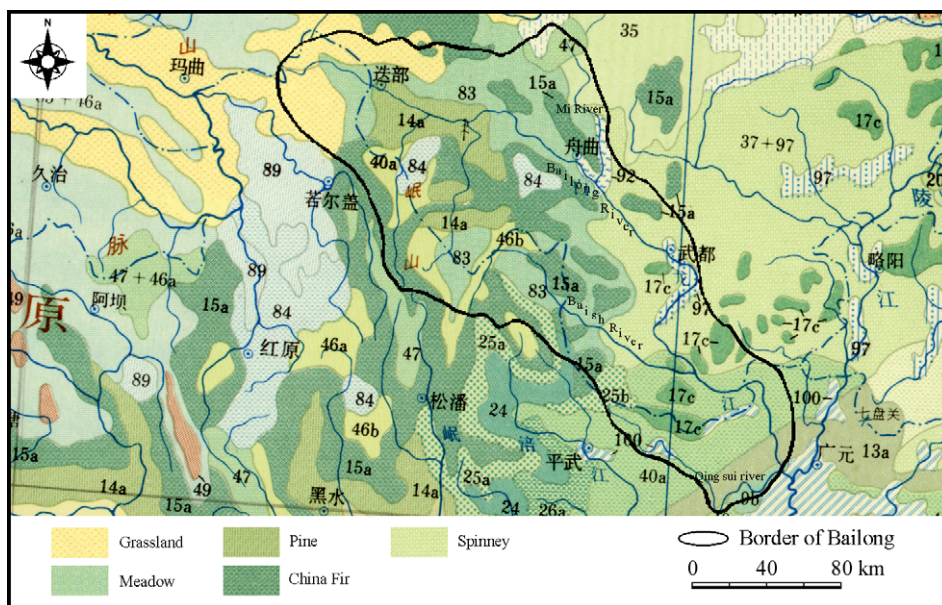
The Ganshu and Sichuan are agricultural provinces in China. The population of the catchment was 25,557,000 in 1990. The climate is cold and dry. There is very little arable land for paddy rice. The main crops are wheat, corn, and potato. It also has a pasturing area.

2. Geographical Information

2.1. Geological Map



2.2. Land Use Map

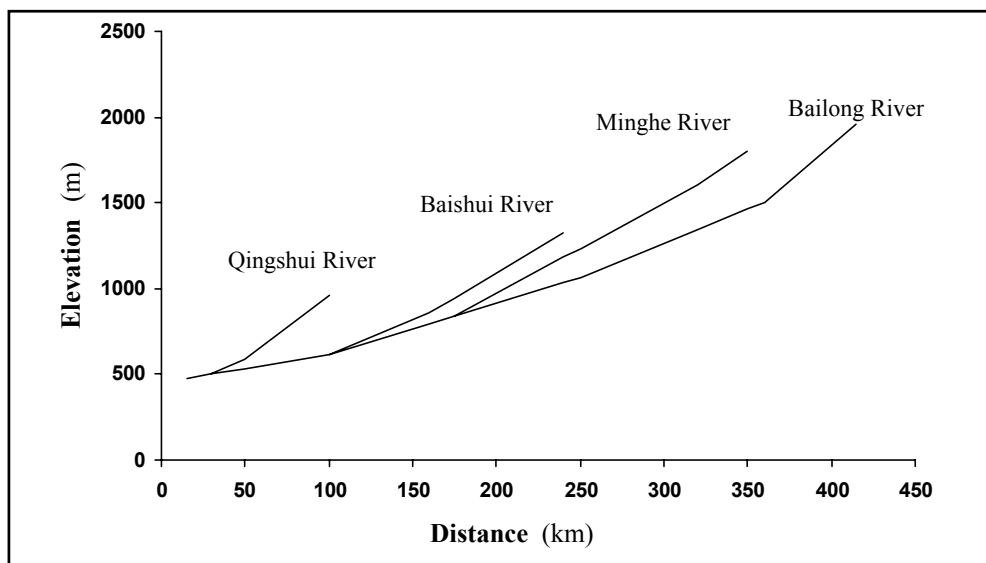


2.3. Characteristics of the River and the Main Tributaries

No.	Name of river	Length[km] Catchment area [km ²]	Highest peak [m] Lowest point [m]	Cities Population (1990)	Land use [%] (1985)
1	Bailongjiang (Main River)	576 31 808	Xiqinshan 5 000 River mouth 16	Wudu 471 166	F (39)
2	Baishuijiang (Tributary)	140 8 134	Minshan 5 000 -	Nanping 53 002	L (0.4) P (0.1)
3	Minhe (Tributary)	89 2 260	Dieshan 3 000 -	Diechang 266 079	OA (41)
4	Qingshuihe (Tributary)	68 3 150	Youshan 5 500 -	Guangyuan 2 877 589	U(20)
5	Rangshuihe (Tributary)	60 782	Mt. Muotianling 2 000 -	Wenxian 221 681	

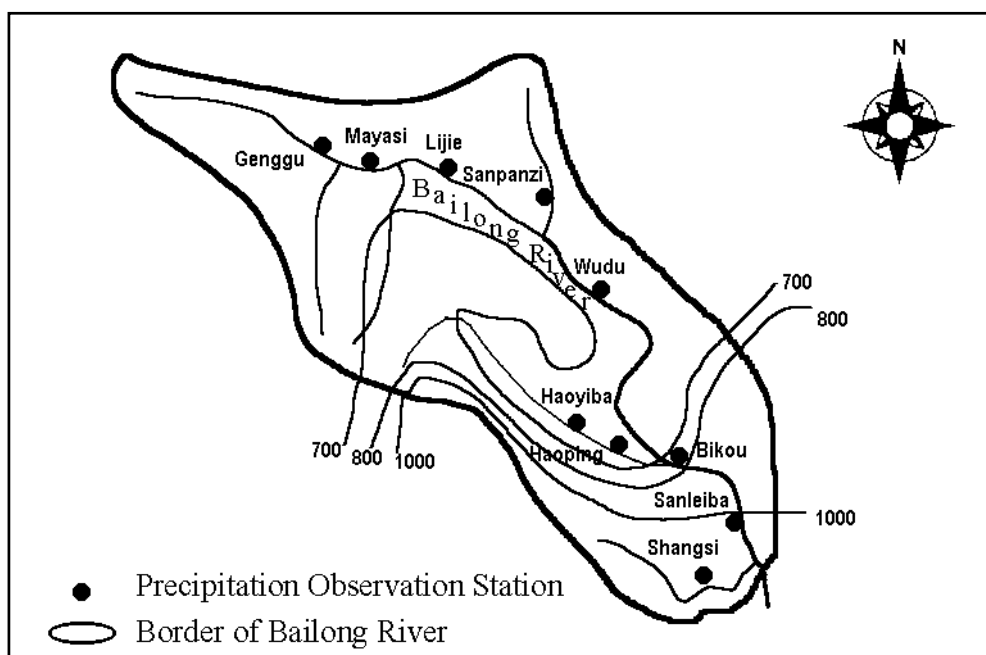
F: Forest L: Lake, River, Marsh P: Paddy Field
 OA: Other agricultural field (vegetable field, grass field)
 U: Urban

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 ¹⁾ [mm]	Mean annual evaporation ¹⁾ [mm]	Observation items ²⁾
97	Sanleiba	488	N 32°27' E 105°38'	1964 ~ present	1 167.3	1 302.8	P(TB),E
93	Bikou	620	N 32°45' E 105°15'	1959 ~ present	867.8	1 269.3	P(TB)
65	Lijie	1 555	N 33°54' E 104°04'	1954 ~ present	545.4	-	P(TB)
89	Nanping	1 406	N 33°15' E 104°14'	1960 ~ present	555.1	1 472.4	P(TB),E
74	Diechang	1 815	N 34°02' E 104°23'	1957 ~ present	634.7	1 353.3	P(TB) ,E
104	Shangsi	550	N 32°18' E 105°28'	1959 ~ present	1 171.0	-	P(TB)

Evaporation used with $\Phi 20$ Evaporation vessel

1) Period for the mean is from 1956 to 1979

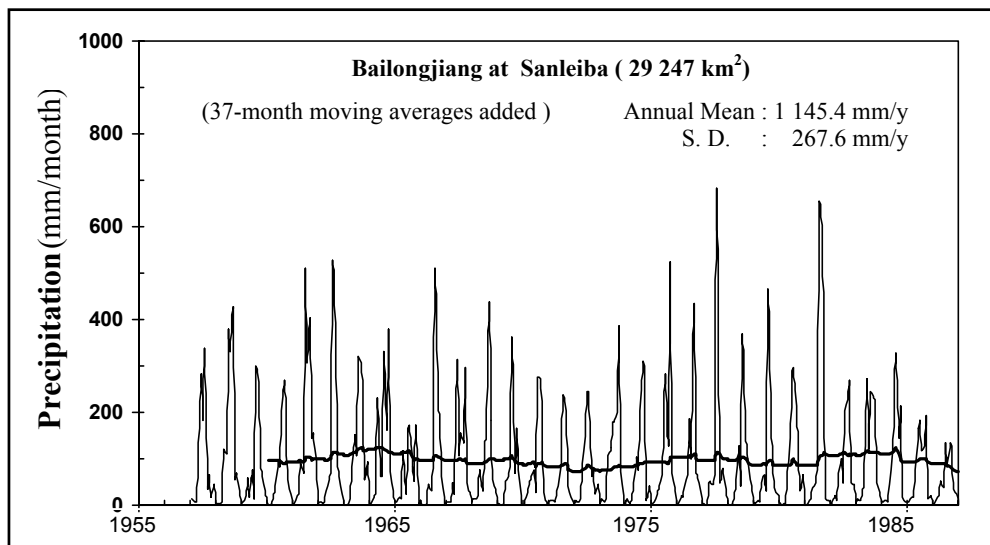
2) P: Precipitation, E: Evaporation, TB: Tipping bucket with recording chart

3.3. Monthly Climate Data at Wudu station

Observation item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Period for the mean
Temperature [°C]	3.0	5.7	10.7	16.1	19.4	22.5	24.6	24.4	19.4	15.0	9.3	4.4	14.6	1971~1985
Precipitation [mm]	1.8	2.7	16.1	37.2	58.2	76.0	87.5	69.0	70.1	36.8	8.5	0.6	464.2	1952~1985
Evaporation [mm]	58.8	66.4	108.1	139.9	165.4	180.1	155.9	140.4	82.4	65.0	54.3	52.6	1269.3	1952~1985
Solar radiation [MJ/m ² /day]*	5.43	10.8	13.2	17.4	18.6	18.6	18.2	18.2	13.5	10.5	8.79	6.60	13.3	1982~1985
Duration of sunshine [hr]	155.2	139.7	149.7	179.9	179.2	176.2	187.2	190.7	123.7	132.8	141.6	168.0	1923.8	1971~1980

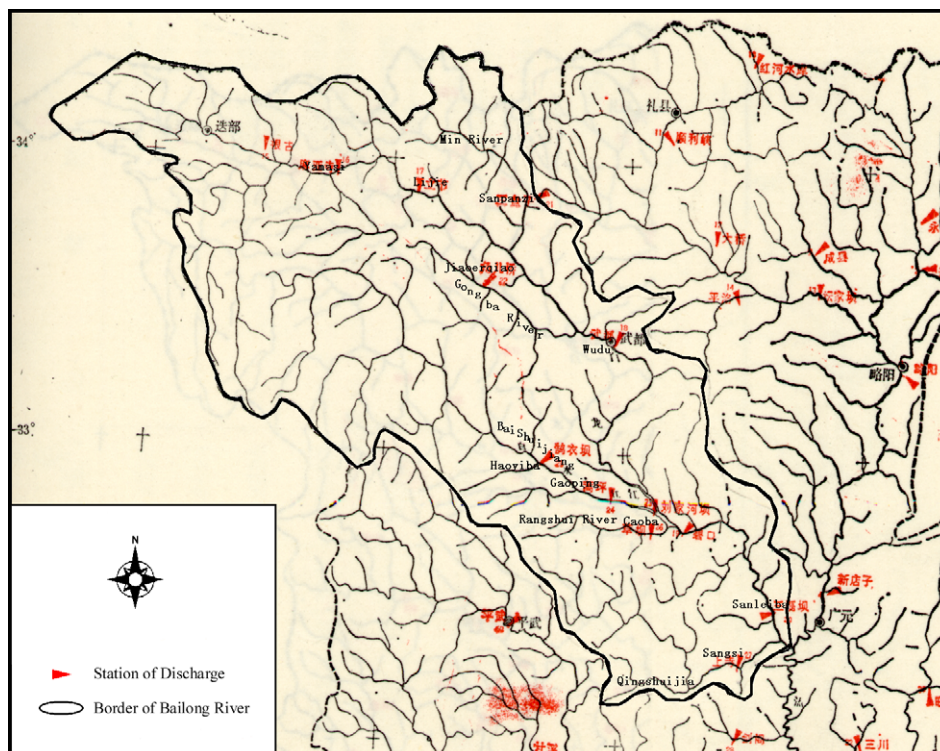
* Observed at Lanzhou

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 (frequency)
21	Wudu	N 33°24' E 104°55'	14 288	1939 ~ present	H2,Q
23	Bikou	N 32°45' E 105°15'	26 086	1939 ~ present	H2,Q
24	Sanleiba	N 32°27' E 105°38'	29 247	1953 ~ present	H2,Q
25	Sanpanzi	N 33°53' E 104°33'	1 978	1965 ~ present	H2,Q
28	Caoba	N 32°44' E 105°05'	702	1970 ~ present	H2,Q
27	Gaoping	N 32°51' E 104°56'	8 134	1970 ~ present	H2,Q
29	Sangsi	N 32°18' E 105°28'	2 450	1957 ~ present	H2,Q

No.	\bar{Q} ¹⁾ [m ³ /s]	Qmax ²⁾ [m ³ /s]	\bar{Qmax} ³⁾ [m ³ /s]	\bar{Qmin} ⁴⁾ [m ³ /s]	\bar{Q}/A [m ³ /s/100km ²]	Qmax / A [m ³ /s/100km ²]	Period of statistics
21	141	1 920	705	46.7	0.99	13.4	1965 ~ 1986
23	278	2 100	1 484	47.1	1.10	8.1	1965 ~ 1986
24	324	8 960	4 294	70.6	1.10	30.6	1965 ~ 1986
25	16.4	280	154	3.74	0.83	14.2	1965 ~ 1982
28	11.5	1 320	593	1.11	1.60	188.0	1970 ~ 1986
27	106	965	485	40.0	1.30	11.9	1971 ~ 1986
29	46.2	7 750	3 082	4.78	1.90	316.0	1971 ~ 1986

H2: water level by manual, Q: discharge

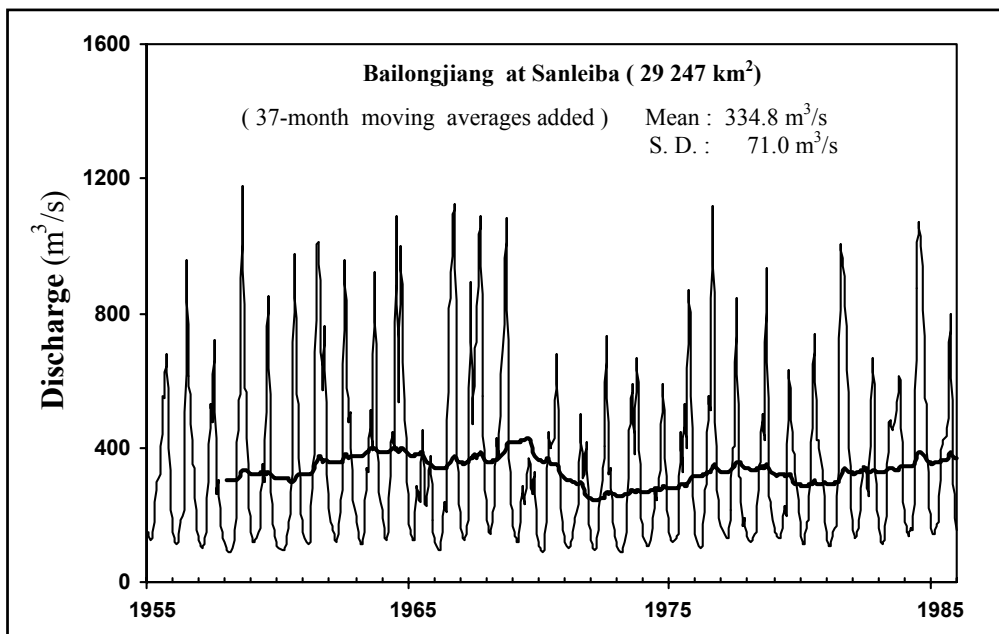
1) Mean annual discharge

2) Maximum discharge

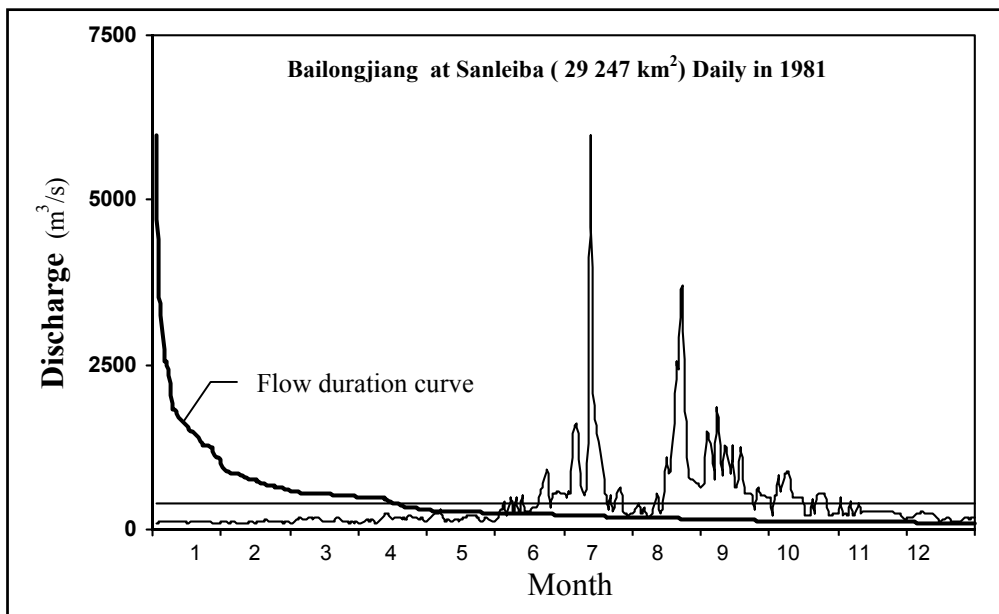
3) Mean maximum discharge

4) Mean minimum discharge

4.3. Long-term Variation of Monthly Discharge Series



4.4. Annual Pattern of Discharge Series

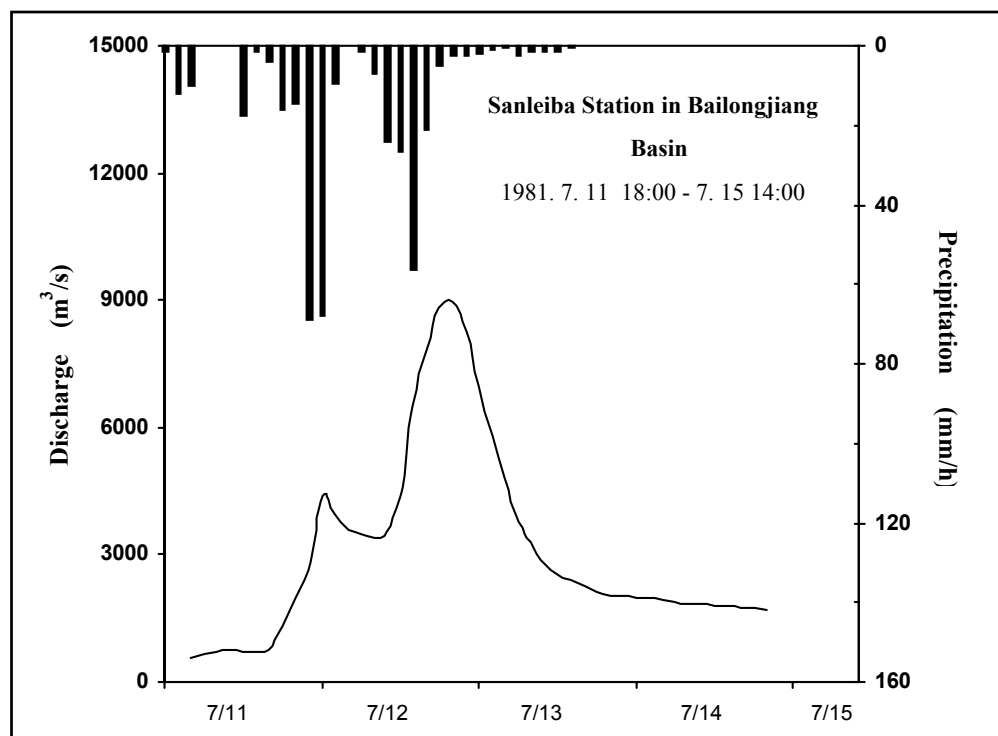


4.5. Annual Maximum and Minimum Discharges at Sanleiba (29 247 km²)

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]
1965	7.21	1 450	12	114	1976	8.28	3 980	3	18.9
1966	9.2	5 460	2	90	1977	7.6	7 490	4	21.3
1967	9.9	4 220	3	113	1978	9.2	7 190	4	31.5
1968	8.4	6 120	2	134	1979	7.14	4 300	4	62.3
1969	7.26	1 180	12	107	1980	6.28	4 860	1	41.9
1970	9.7	3 870	2	88.2	1981	7.13	8 960	4	57.6
1971	7.9	4 000	2	95.4	1982	9.1	2 530	1	65.1
1972	7.8	4 910	3	93.2	1983	9.7	6 540	12	31.3
1973	7.8	2 360	3	81	1984	6.22	4 810	3	88.2
1974	9.4	2 510	3	105	1985	9.13	2 510	3	57.4
1975	9.5	4 360	12	14.0	1986	6.15	853	4	44.0

1), 2) Instantaneous observation by recording chart

4.6. Hyetographs and Hydrographs of Major Floods



5. Water Resources

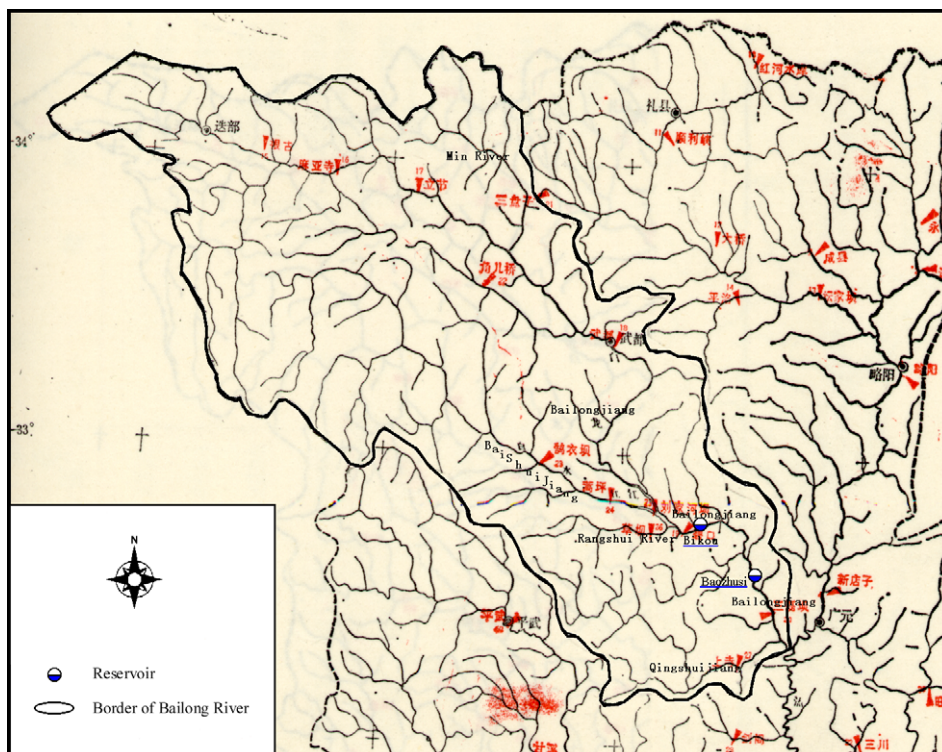
5.1. General Description

The Bailong Jiang is the main tributary of Jialing Jiang in the Yangtze River basin. The main river and tributaries originate from the north-west mountains and Tibet Plateau.

Approximately 66.4 % of the annual precipitation in the basin is concentrated in the period from June-September. According to the records of Bikou and Sanleiba hydrological stations, the distributions of precipitation and runoff are quite stable through the years. The coefficient of variation of average runoff at Bikou and Sanleiba are 0.24 and 0.21 respectively. Usually, there are two to three floods per year, caused mainly by storms.

There are two cascade reservoirs, Bikou and Baozhushi, completed in 1976 and 1997, with capacities of $521 \times 10^6 \text{ m}^3$ and $2\,450 \times 10^6 \text{ m}^3$ respectively. The purpose of Bikou reservoir is hydropower generation with flood control and navigation. The Baozhushi is a key project in the cascade development of the middle and lower streams of Bailong Jiang. The catchment area at the dam site is $28\,896 \text{ km}^2$, which is about 89.4 % of the river basin area. It is also a regulating station for Sichuan power grid, which will improve operation of energy systems. The design return period for flood control is one in thousand years.

5.2. Map of Water Resource Systems



5.3. List of Major Water Resources Facilities

Major Reservoirs

Name of river	Name of dam	Catchment area [km ²]	Gross capacity [10 ⁶ m ³]	Effective capacity [10 ⁶ m ³]	Purpose ¹⁾	Year of completion
Bailongjiang	Bikou	26 010	521	450	P,F	1976
Bailongjiang	Baozhushi	28 896	2 451	1 307	P,F	1996

1) F: Flood control, P: Hydro-power

5.4. Major Flood and Drought Experiences

Major Floods at Sanleiba (Catchment area 29 247 km²)

Date	Peak discharge [m ³ /s]	Rainfall [mm] Duration	Meteorological cause	Major damages (Districts affected)
1981.7.9	8 960	393.3 7.9~7.14	Frontal rain	Guangyuan, Qingchuan City etc

Major Droughts

Period	Affected area	Major damages and counteractions
1978.7~10	Guangyuan City	Water supply cut ratio 76 %

6. Socio-cultural Characteristics

During the first civil war in the 1920s, Chinese workers and Farmers Red Army passed through Min Mountain and Grass areas near the boundary of Sichuan and Gansu Provinces. The nearest communication channel between the two provinces had been created during that time. A road for Lanzhou in Gansu and Arba in Sichuan, through the Mountain and the Grass, had been constructed. Memorial statues stand at the two ends of the road.

Baozhushi means excellent pearl temple in Chinese. It is said that Bodhisattva is very clever in the temple. The people from Sichuan and Gansu, belonging to both the majority and the minority, go to the temple to ask for fortune each year. In the southern part of the basin, there are sub-tropical plants, especially bamboo. The basin of Baishuijiang, a tributary of Bailongjiang, is one of the panda natural protection areas.

7. References, Databooks and Bibliography

- Geology Press, (1973): The atlas of geology in China.
 China Atlas Press, (1978): *China Meteorology Atlas*.
 Gansu Water Resources Planning and Design Institute, (1980): *Water resources development for Gansu Province*.
 Sichuan Water Resources Planning and Design Institute, (1980): *Water resources development for Sichuan Province*.
 Yangtze River Water Commission (1952-1980): The year-book of hydrological data in Yangtze river basin.
 China Bookstore Press, (1992): China Historical Floods.
 China Population Investigation, (1994): *China Statistical Press*.