

Sapkyo-chun

Map of River



Geographical Survey, MOCT, Korea

Table of Basic Data

Name(s): Sapkyo-chun		Serial No. : Korea (R. of) -12
Location: Chungnam Province, Korea	E 126° 36' 29" ~ 127° 12' 51"	N 36° 23' 34" ~ 36° 34' 20"
Area: 1,612.0 km ²	Length of the main stream: 63.47 km	
Origin: Mt. Jo Chup (791 m)	Highest Pt: Mt. Jo Chup (791 m)	
Outlet: A-san Bay	Lowest Pt: A San Bay (D. W. L - 1.50 m)	
Main base rocks: Granite, metamorphic rock, a pyrogenic rock		
Main tributaries: Muhan-chun (465.04 km ²), Gokkyo-chun (542.14 km ²)		
Main lakes: Sapkyo Lake (84.1 × 10 ⁶ m ³)		
Main reservoirs: Yedang Reservoir (47.1 × 10 ⁶ m ³)		
Mean annual precipitation: 1,254.0 mm (1983 ~ 92) (basin average)		
Mean annual runoff: 2.2 m ³ /s at Suchun		
Population: 561,943 (1993)	Main cities: Yesan, Hongsung, A-san	
Land use: Forest (48.5%), Rice Paddy (25.2%), Agriculture (13.13%), Urban (3.63%), Others (9.54%), (1993)		

1. General Description

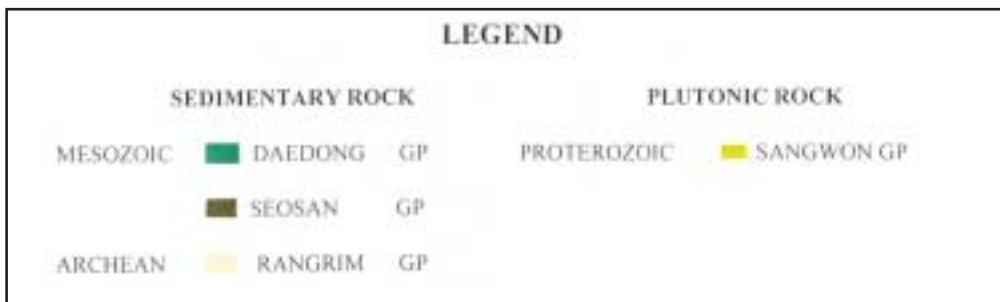
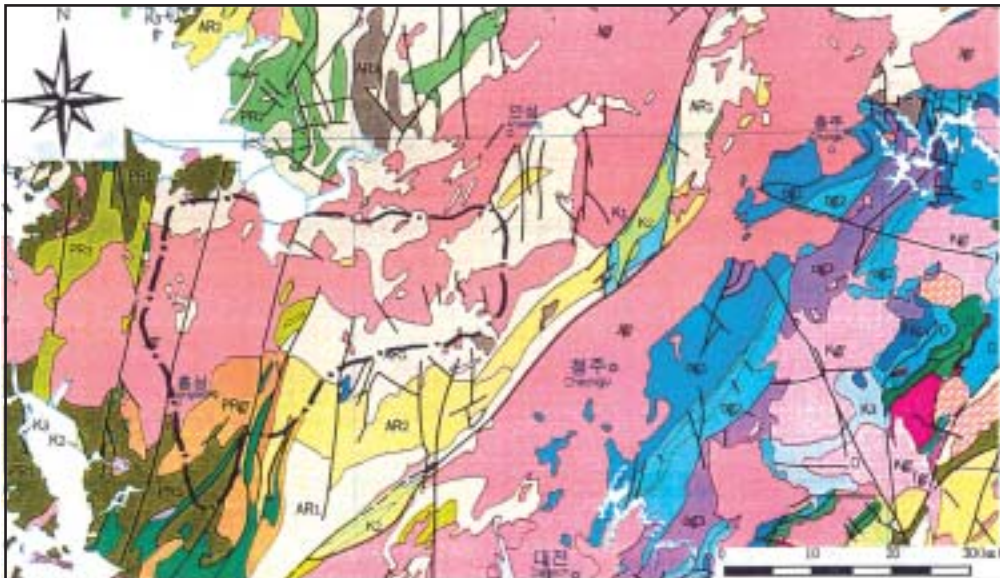
The Sapkyo-chun is located in the middle-west of the Korean peninsula and consists of two tributaries, the Muhan-chun, and the Kogkyo-chun. The catchment area is 1,612.1 km² and the length of river is 63.47 km. This river originates from Jochop Mountain (EL. 791.0 m) and flows into the Sapkyo Sea.

The average annual precipitation of the river basin is 1,254 mm and the average annual runoff is 2.2 m³/sec at the Suchun water level gauging station. The total population of the Sapkyo river basin was 561,943 persons in 1993. The Sapkyo Sea Dike for the supply of irrigation water was completed in 1979 and has 84.1million m³ of gross storage capacity.

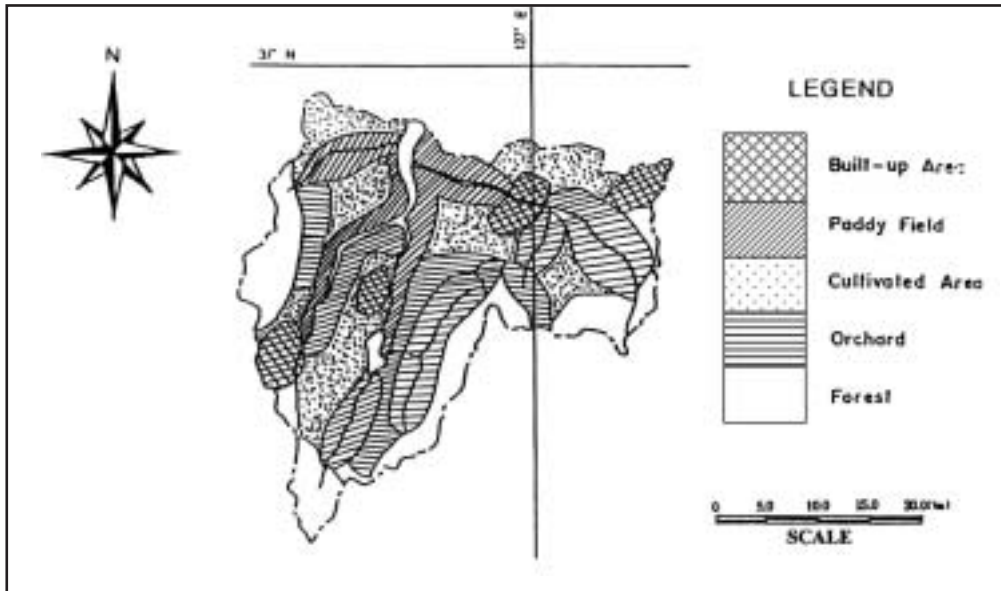
Hongsung and Yesan cities in the Sapkyo river basin were built on well-developed plains and small hills, and are typical of modernized rural villages.

2. Geographical Information

2.1 Geological Map



2.2 Land Use Map

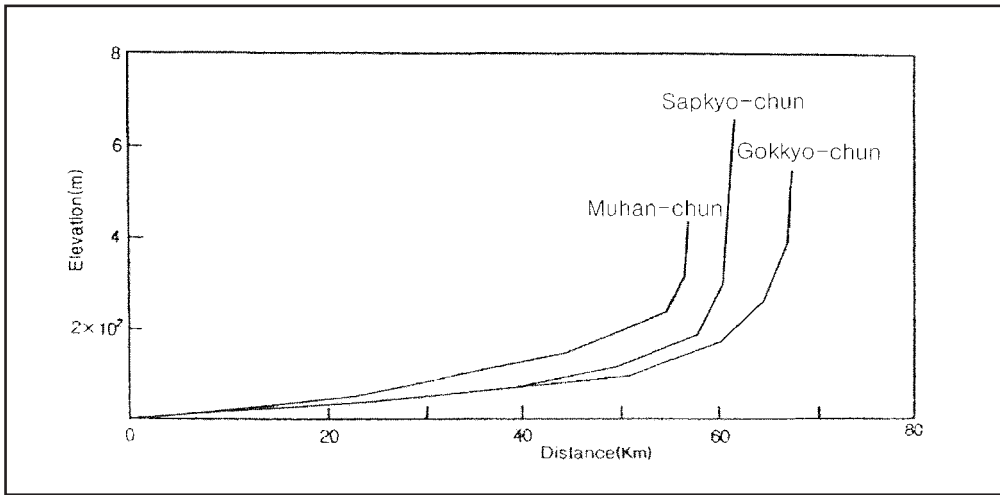


2.3 Characteristics of the River and the Main Tributaries

No.	Names of River	Length [km] Catchment area [km ²]	Highest peak [m]	Cities Population (1999)	Land use [%]
1	Sapkyo-chun (Main River)	63.47 634.72	Mt. Gaya 671.0	Hong Sung Gun 57,672	F (48.45) P (25.2) U (3.63) A (11.08) L (0.0) O (2.10)
2	Muhan-chun (Tributary)	48.24 465.04	Mt. Bong Su 534.4	YeSan City 114,695	
3	Gokkyo-chun (Tributary)	58.26 542.14	Mt. Seunggyu 574.0	ChunAn City 205,665	
				A-San City 123,525	

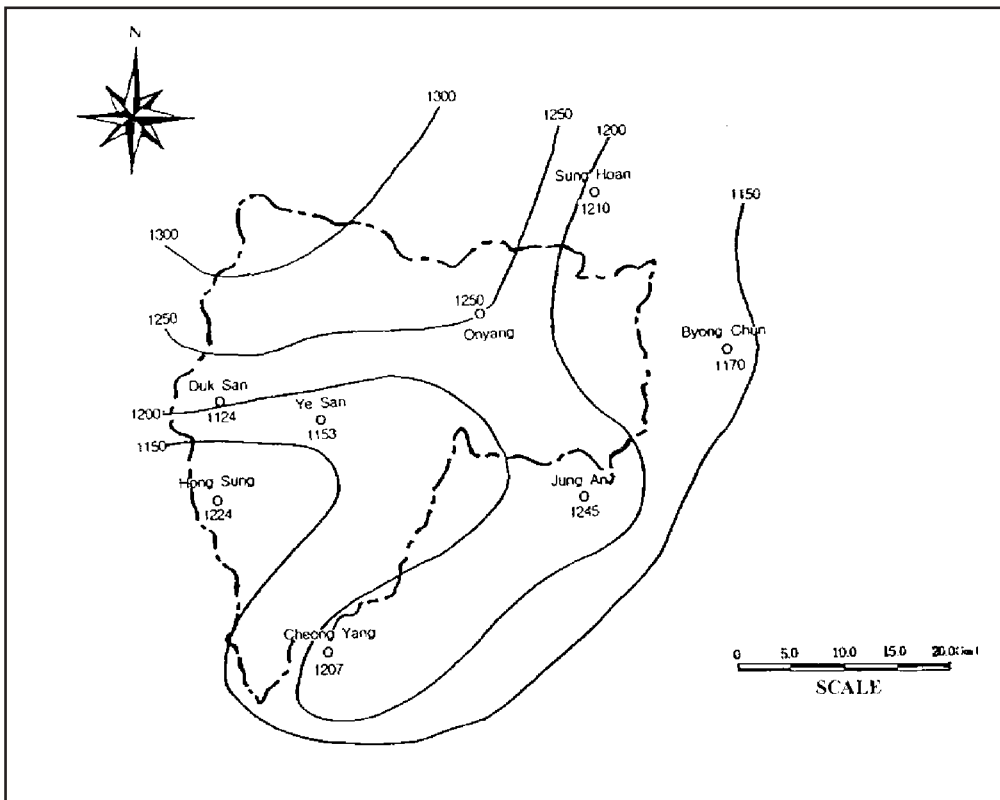
F: Forest L: Lake, river, marsh P: Paddy field U: Urban O: Orchard
A: Agricultural field (vegetable field, grass field)

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyetal Map and Observation Stations



Based on the data of Ministry of Construction and Transportation

3.2 List of Meteorological Observation Stations

No.*	Station	Elevation [m]	Location	Observation period	Mean annual Precipitation ¹⁾ [mm]	Mean annual evaporation ²⁾	Observation items**
256	Yesan	50.0	N 36° 41' 05" E 126° 47' 33"	1933.9 ~ present	1,153.24		P (TB)
257	Ducksan	20.0	N 36° 31' 53" E 126° 40' 04"	1957 ~ present	1,224.80		P (TB)
258	Hongsung	30.0	N 36° 35' 59" E 126° 39' 46"	1918 ~ present	1,124.70		P (TB)
38	A-san	24.5	N 36° 47' 00" E 126° 59' 00"	1971 ~ present	1,250.30	1,002.9	P (TB)

* Serial number used by Ministry of Construction and Transportation

** P: Precipitation, TB: Tipping bucket with recording chart

1) Period for the mean is from the beginning of the observation period to 1992

2) Measured by 20 cm pan

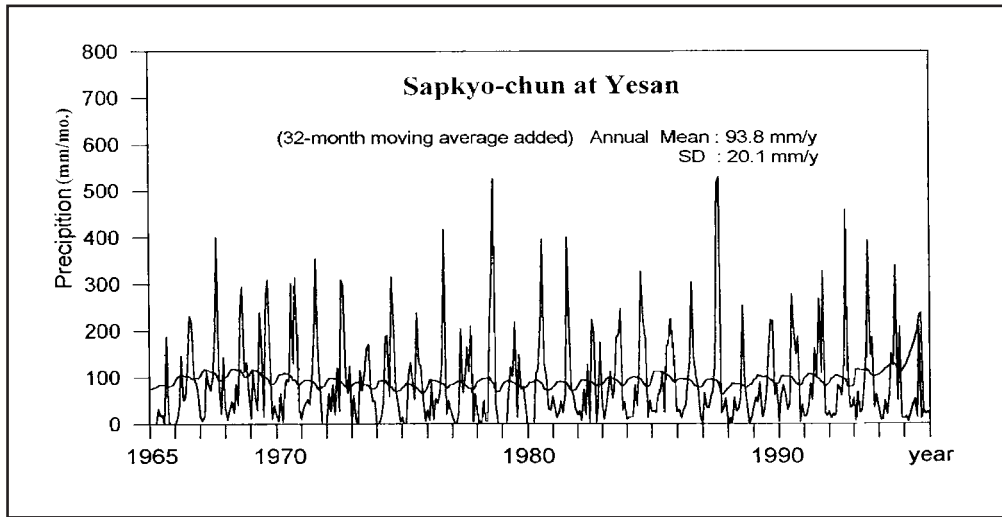
3.3 Monthly Climate Data

Station: A-san

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	-2.91	-1.05	4.37	11.35	17.12	21.5	24.78	25.15	19.91	13.12	6.43	-0.05	11.64	1982~1994
Precipitation [mm]	23.8	31.2	52.3	54.4	88.1	119.2	252.0	248.1	152.6	101.0	115.5	43.9	1,282	1982~1994
Evaporation [mm]*	29.79	39.68	66.95	111.6	136.0	137.6	119.6	126.7	98.51	77.27	41.06	29.82	1,014.5	1982~1994
Duration of sunshine [hr]	172.2	188.5	224.2	248.1	264.0	348.0	210.3	235.0	214.8	220.1	165.3	161.3	2,551.9	1982~1994

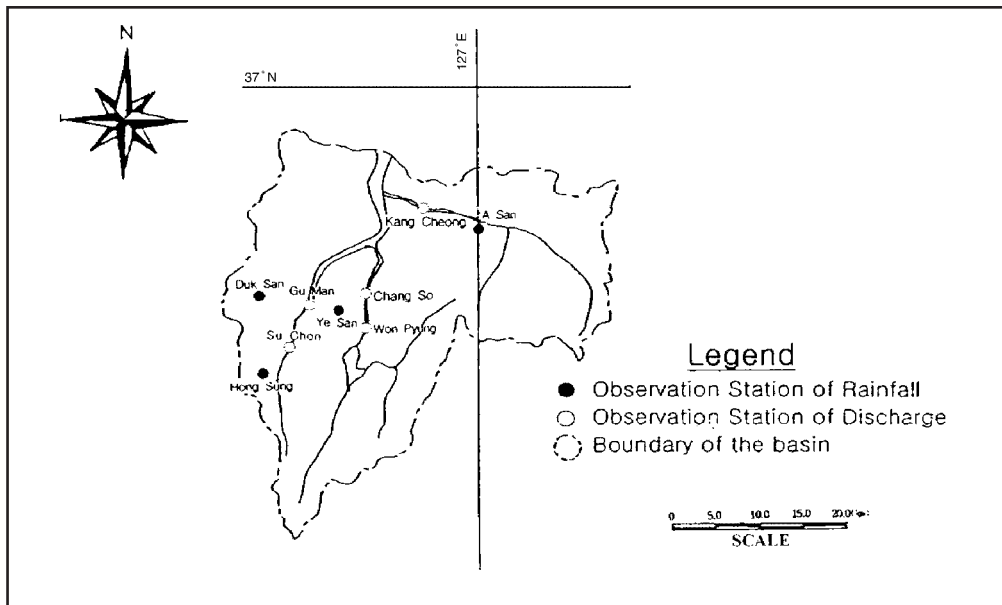
*measured by 20 cm pan

3.4 Long-term Variation of Monthly Precipitation Series



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]
163	Su Chon	N 36° 41' 00" E 126° 43' 57"	223.26	1945 ~ present	H1
162	Gu Man	N 36° 44' 00" E 126° 45' 25"	317.50	1962 ~ present	H1
167	Won Pyong	N 36° 40' 51" E 126° 49' 23"	379.50	1929 ~ present	H1
166	Chang So	N 36° 45' 55" E 126° 50' 00"	420.30	1962 ~ present	H1
165	Kang Cheong	N 36° 49' 17" E 126° 56' 06"	433.70	1962 ~ present	H1

No.*	\bar{Q} ²⁾ [m ³ /s]	Qmax 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]	Qmax/A [m ³ /s/100km ²]	Period of statistics
163	0.79	350.3	80.87	0.019	0.350	1.57	1976 ~ 1995
167	0.27	802.7	45.29	0.049	0.071	2.12	1976 ~ 1995
165	19.45	750.4	228.25	1.250	4.480	1.73	1976 ~ 1995

* Serial number used by Ministry of Construction and Transportation

1) H1: water level in recording chart

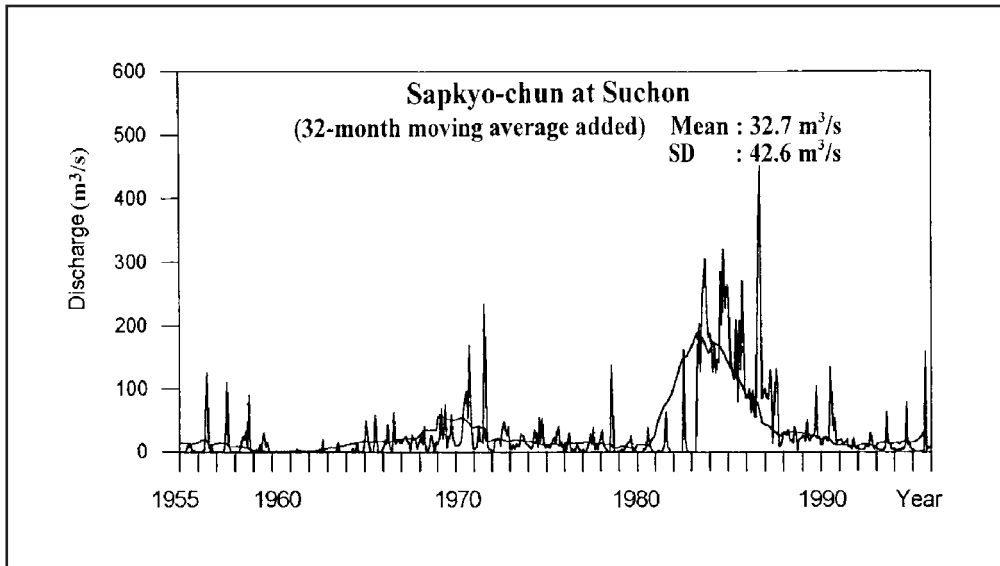
2) Mean annual discharge

3) Maximum discharge

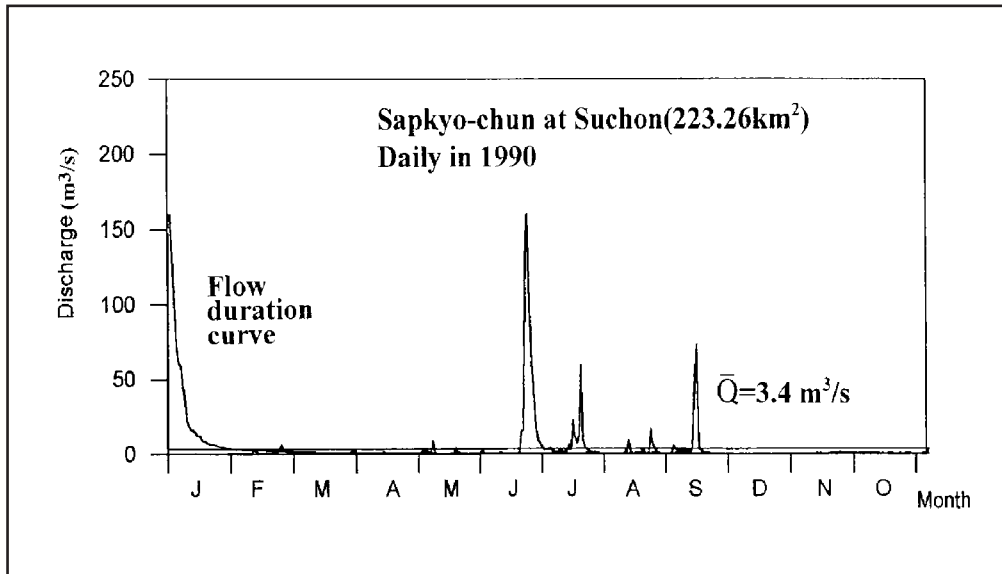
4) Mean annual maximum discharge

5) Mean annual minimum discharge

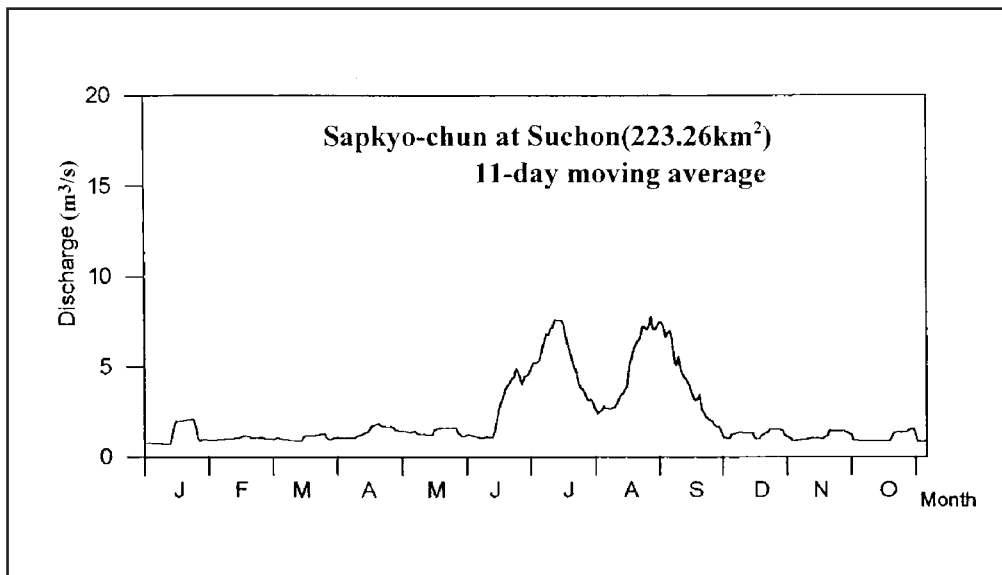
4.3 Long-term Variation of Monthly Discharge Series



4.4 Annual Pattern of Discharge Series



4.5 Unique Hydrological Features



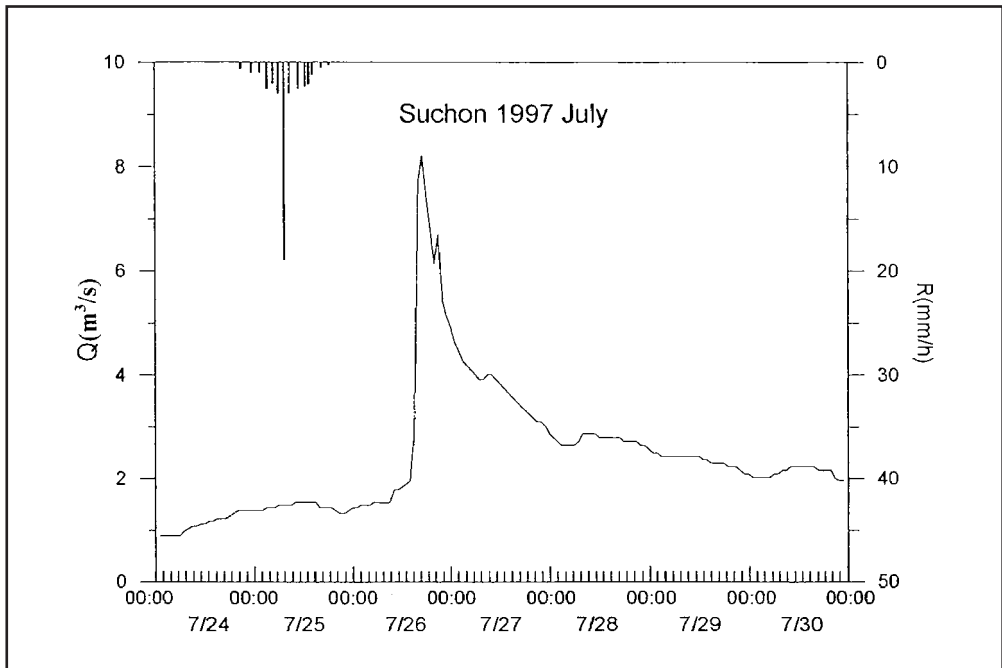
4.6 Annual Maximum and Minimum Discharges

Station: Suchon (223.26 km²)

Year	Maximum		Minimum		Year	Maximum		Minimum	
	Date	Discharge ¹⁾ [m ³ /s]	Month	Discharge ²⁾ [m ³ /s]		Date	Discharge ¹⁾ [m ³ /s]	Month	Discharge ²⁾ [m ³ /s]
1971	7.26	97.86	1	2.29	1984	7.14	97.86	11	1.39
1972	7.9	32.35	1	1.63	1985	10.10	102.91	2	1.62
1973	7.3	8.99	8	2.21	1986	7.19	269.49	6	4.87
1974	7.9	57.54	11	2.59	1987	8.29	195.66	5	2.35
1975	8.6	18.20	5	1.75	1988	7.17	9.26	9	1.91
1976	2.16	11.49	2	1.39	1989	9.15	331.20	5	1.79
1977	7.13	21.71	6	1.69	1990	6.22	185.42	1	3.27
1978	7.7	67.85	1	1.65	1991	5.25	20.13	7	2.04
1979	6.26	79.62	12	2.12	1992	8.28	25.09	8	2.29
1980	7.14	40.25	6	1.72	1993	7.13	100.87	5	2.39
1981	7.12	80.46	6	0.72	1994	8.29	64.96	8	1.87
1982	7.15	131.49	6	0.82	1995	8.92	137.92	9	1.76
1983	8.24	55.64	1	1.65					

1), 2) Instantaneous observation by recording chart

4.7 Hyetographs and Hydrographs of Major Floods



5. Water Resources

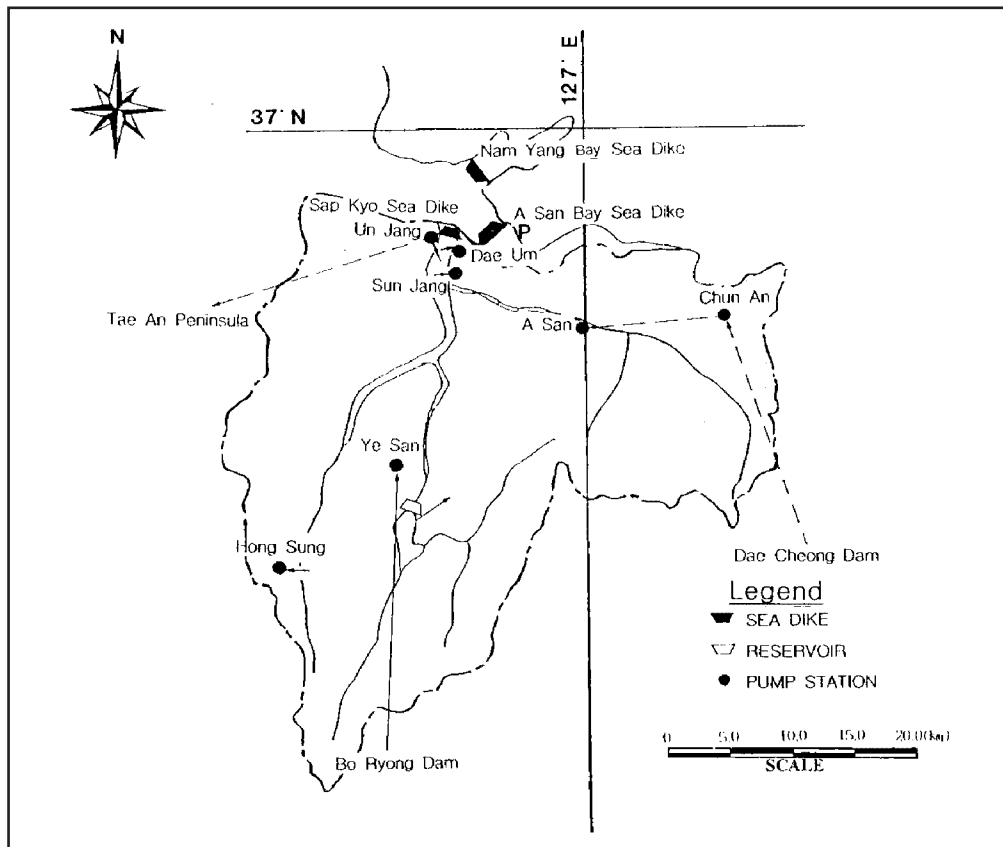
5.1 General Description

The Sapkyo-chun flows into the Yellow Sea from the middle part of the Korean peninsula. The Sapkyo-chun has a total catchment area of 1,612.0 km² and consists of a main stream and two tributaries, the Muhan-chun and the Gokkyo-chun. About 38.4% of the total river basin is cultivated land and 48.5% is forested.

Of the total annual runoff, 75.6% occurs in the flood season, June to September, with the remaining 24.4% being spread through the rest of the year.

The total amount of municipal water needed for cities in the basin is 33.46 million m³/year and this has been supplied from outside the basin by the Daechong wide area water supply system. Of the 53,918 m³/day used by industry, 20,500 m³/day comes from the Daechong wide area system. The remaining industrial water demand has been met by private industry developing its own sources. Irrigation water demand is 336.9 million m³/year and a further 52 million m³/year is diverted from the Sapkyo-chun to other river basins. Chunnan City, which is the biggest city in the Sapkyo area, uses 92,000 m³/day supplied from the Daechong wide area water system.

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
Sapkyo-chun	Sapkyo Sea Dike	1,612.0	84	-	A, I, W	1979
Muhan-chun	Yedang Reservoir	373.60	47.1	46.04	A	-

1) W: Municipal water supply I: Industrial use A: Agricultural use.

Major Interbasin Transfer

Name of Transfer line	Name of rivers connected		Length [km]	Maximum Capacity [m ³ /s]	Purpose ¹⁾	Year of Completion
	From	To				
Daechong Wide Area Water Supply	Daechong Dam	A-san Filter Plant	115.0	11.34	W	1988
Boryong Wide Area Water Supply	Boryong Dam	Hongsung Filter Plant	55.5	0.14	W	1998
Boryong Wide Area Water Supply	Boryong Dam	Yesan Filter Plant	55.5	0.15	W	1998
Sapkyo-chun Line	Sapkyo-chun	Tangjin Filter Plant	34	207.4	A, I	1998

1) W: Municipal water supply I: Industrial use A: Agricultural use.

5.4 Major Floods and Droughts

Major Floods

Date	Peak Discharge [m ³ /s]	Rainfall [mm] Duration	Meteorological Cause	Dead and missing	Major damages (Districts affected)
1980.7.19	379.28	181.2 7.19 ~ 22	Storm	17	Yesan
1981.7.11	228.25	165.0 7.11 ~ 13	Storm	-	Hongsung
1984.9.1	620.63	149.5 9.1 ~ 3	Storm	-	Duksung
1990.6.17	178.78	153 6.17 ~ 19	Storm	-	A-san
1995.8.23	750.39	417.5 8.23 ~ 25	Storm	-	Yesan

Major Droughts

Period	Affected Areas	Major damages and counteractions
1977. 1 ~ 4	A-san, Onyang	Supply cut ratio at the first stage: 10%
1987. 1 ~ 7	Chunan	Damage of the crops: 10%
1994. ~ 1995.	Chunan, Onyang	Supply cut ratio at the first stage: 20%

5.5 Groundwater and Water Quality

River Water Quality¹⁾ at Sapkyo-chun²⁾, 1995

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pH	7.1	7.2	7.1	7.1	7.3	7.4	7.8	6.7	6.9	7.5	7.5	7.8
BOD [mg/l]	13.0	14.0	14.0	8.6	10.0	8.3	8.0	9.0	8.2	9.7	9.1	5.7
COD _{Mn} [mg/l]	7.4	7.6	7.0	9.0	10.0	11.4	7.5	6.2	8.0	8.1	8.5	5.2
SS [mg/l]	4.7	10.4	9.8	13.4	17.0	32.8	28.0	22.0	22.0	14.0	14.3	15.0
Coliform group [MPN/100ml] ³⁾	900	1100	900	940	1100	1400	900	350	300	500	130	220
Discharge [m ³ /s] ⁴⁾	7.33	8.75	9.19	8.50	3.54	0.91	2.59	4.82	2.73	3.31	3.38	5.58

1) Observed once a month on a dry day normally several days after rainfall.

2) Located near the Observation Station 2 km from the Sapkyo Sea Dike

3) Measurement method: BGLB (brilliant green lactose bile) method.

4) Discharge on the observation date.

6. Socio-cultural Characteristics

The Sapkyo-chun flows into the A-san bay. The three sea-dikes of Sapkyo, A-san and Namyang are located in the A-san bay and the reservoirs created by these three dikes supply irrigation water to the basin.

There are many cities and counties such as Chunan City, A-san City, Yesan County and Hongsung County in the basin. Chunan is the second city in Chungnam province. The Onyang and Togo districts are the best known hot-spring resorts in Korea. Sudock temple, which is located in Yesan county, is very old and is one of best-known sights in the county.

The Sapkyo-chun basin has been developed as a typical agricultural area. The Yedang Reservoir was constructed for irrigation while the Sapkyo Sea Dike was constructed for both irrigation and municipal and industrial water supply in 1979.

7. References, Databooks and Bibliography

Ministry of Construction, Report on the Basic Plan for Integrated Development of the Sapkyo-chun, 1994 (2.3)

Chungnam Province office, Report on the Basic Plan for Integrated Development of the Sapkyo-chun, 1986 (5.1, 5.3)

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Korea Meteorological Administration, Annual Climatological Report, 1994-1995 (3.3)