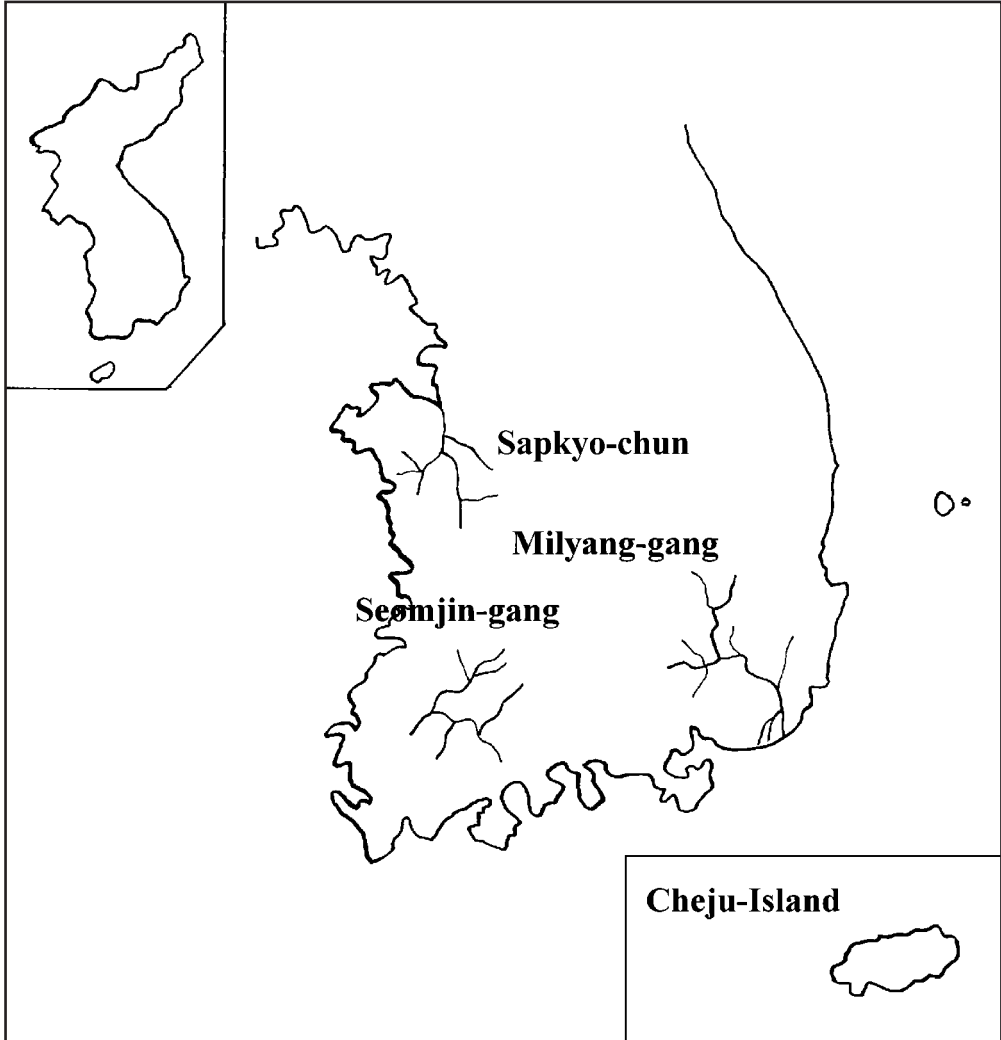


# Republic of Korea

**Korea-10: Seomjin-gang**

**Korea-11: Milyang-gang**

**Korea-12: Sapkyo-chun**



## Introduction

The Korean peninsula, which lies between the Yellow Sea and the East Sea, is about 1,300 km long and 300 km wide and is located at the eastern end of the Asian continent. The eastern coast line of the peninsula runs directly along the edge of steep mountain ranges, while the curved shapes of the western and southern coast lines indicate the occurrence of wide alluvial plains. In general, rivers running to the eastern coast are short and steep. Long rivers with gentle slopes, such as the Han River, the Geum River, the Nakdong River, and the Seomjin River, discharge to the southern or western coasts.

Korea is in the moderately humid zone of medium latitudes. It has a definite, seasonal climate that is greatly defined by dry, cold continental air masses during the winter, and humid warm air masses from the ocean during the summer. The average annual temperature is 14° C (57° F) along the southern coast, while it drops to as low as 11° C and 8° C (52° F and 46° F), respectively, over the mid and northern climatic zones. The yearly distribution of precipitation is determined by westerly and north-westerly dry winds from the Asian continent in the winter and moist south-easterly winds from the Pacific Ocean in the summer. Thus the rainfall is concentrated in the summer. Of the annual precipitation of 1,274 mm, approximately 66% occurs during the rainy season from June to September, 16% during the transition period from April to May, and the remaining 18% during the six months from October to March. As of 2000, the population of Korea was 46,136,000 with a population density of 462 person/km<sup>2</sup>. Of a total land area of 99,450 km<sup>2</sup>, farm lands account for 21,379 km<sup>2</sup> while forests cover about 63,762 km<sup>2</sup>.

The three rivers catalogued in this volume are the Seomjin-gang, the Milyang-gang, and the Sapkyo-chun. They are representative of Korean rivers. The Seomjin-gang is the fourth largest river in Korea, and flows through the south-western part of the Korean peninsula. The Milyang-gang is one of the main tributaries of the Nakdong river which flows through the south-eastern part of the Korean peninsula. The Unmun and Milyang Dams play important roles by providing drinking water to the residents of nearby Taegu, Milyang and other areas. The Sapkyo-chun is located in the north-west of the Geum river basin and is a typical agricultural area. At the estuary of the Sapkyo-chun, the Sapkyo sea-dike was constructed for the irrigation in 1979.

## Acknowledgements

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Lee, Soontak (Chair), Yeungnam University,  
Ahn, Sang-Jin, Choongbuk University, and  
Chun, Byung-Ho, Korean Military Academy.

The organizations that have contributed include:

The River Planning Division, Water Resources Bureau, Ministry of Construction and Transportation,  
The Han River Flood Control Office, Ministry of Construction and Transportation,  
The Nakdong River Flood Control Office, Ministry of Construction and Transportation,  
The Geum River Flood Control Office, Ministry of Construction and Transportation,  
The Korean Water Resources Association, and  
The Korean Water Resources Corporation.

## Sapkyo-chun

### Map of River



Geographical Survey, MOCT, Korea

### Table of Basic Data

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

## 1. General Description

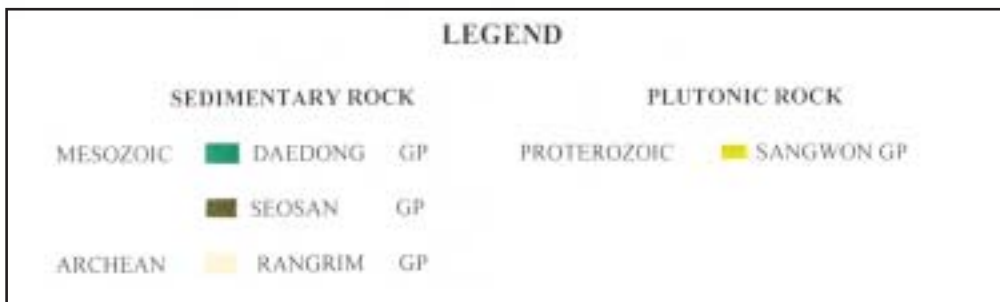
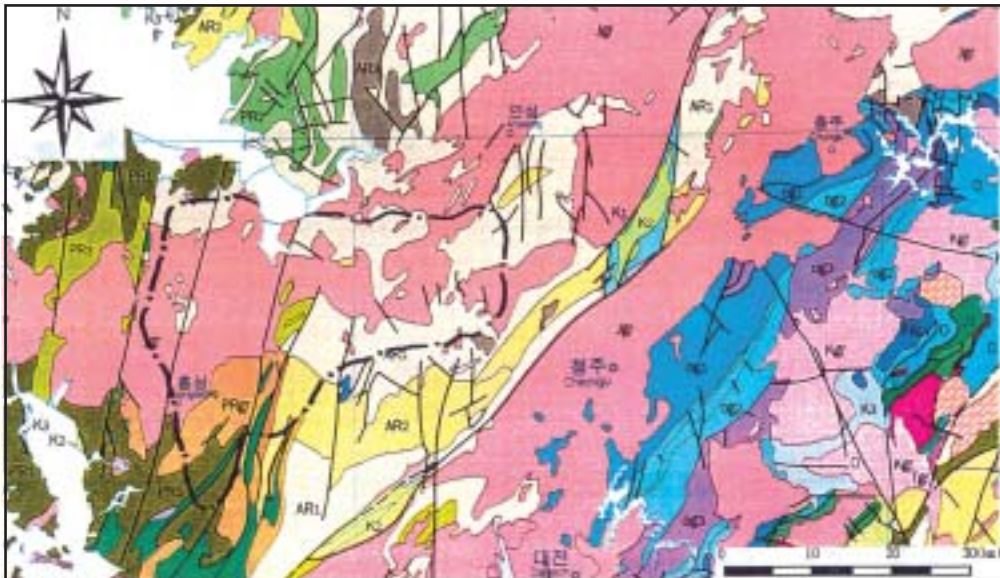
The Sapkyo-chun is located in the middle-west of the Korean peninsula and consists of two tributaries, the Muhan-chun, and the Kogkyo-chun. The catchment area is 1,612.1 km<sup>2</sup> and the length of river is 63.47 km. This river originates from Jochop Mountain (EL. 791.0 m) and flows into the Sapkyo Sea.

The average annual precipitation of the river basin is 1,254 mm and the average annual runoff is 2.2 m<sup>3</sup>/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 m<sup>3</sup> of gross storage capacity.

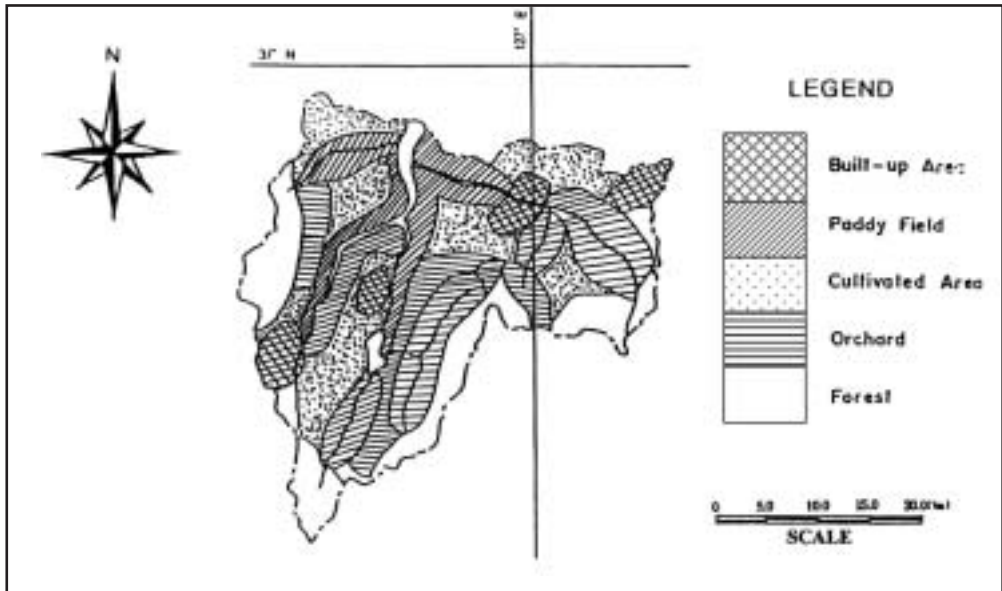
Hongsung and Yesan cities in the Sapkyo river basin were built on well-developed plains and small hills, and are typical of modernized rural villages.

## 2. Geographical Information

### 2.1 Geological Map



2.2 Land Use Map

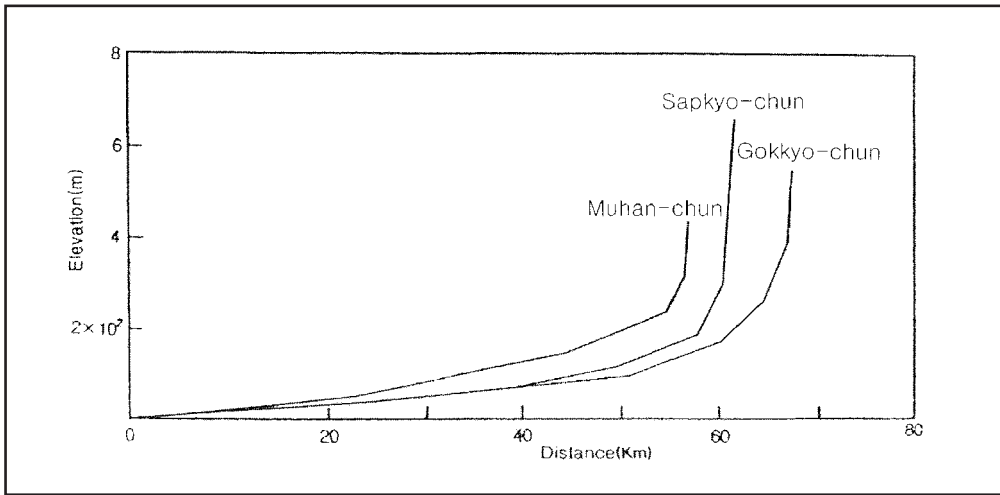


2.3 Characteristics of the River and the Main Tributaries

No.	Names of River	Length [km] Catchment area [km <sup>2</sup> ]	Highest peak [m]	Cities Population (1999)	Land use [%]
1	<b>Sapkyo-chun</b> (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	<b>Muhan-chun</b> (Tributary)	48.24 465.04	Mt. Bong Su 534.4	YeSan City 114,695	
3	<b>Gokkyo-chun</b> (Tributary)	58.26 542.14	Mt. Seunggyu 574.0	ChunAn City 205,665	
				A-San City 123,525	

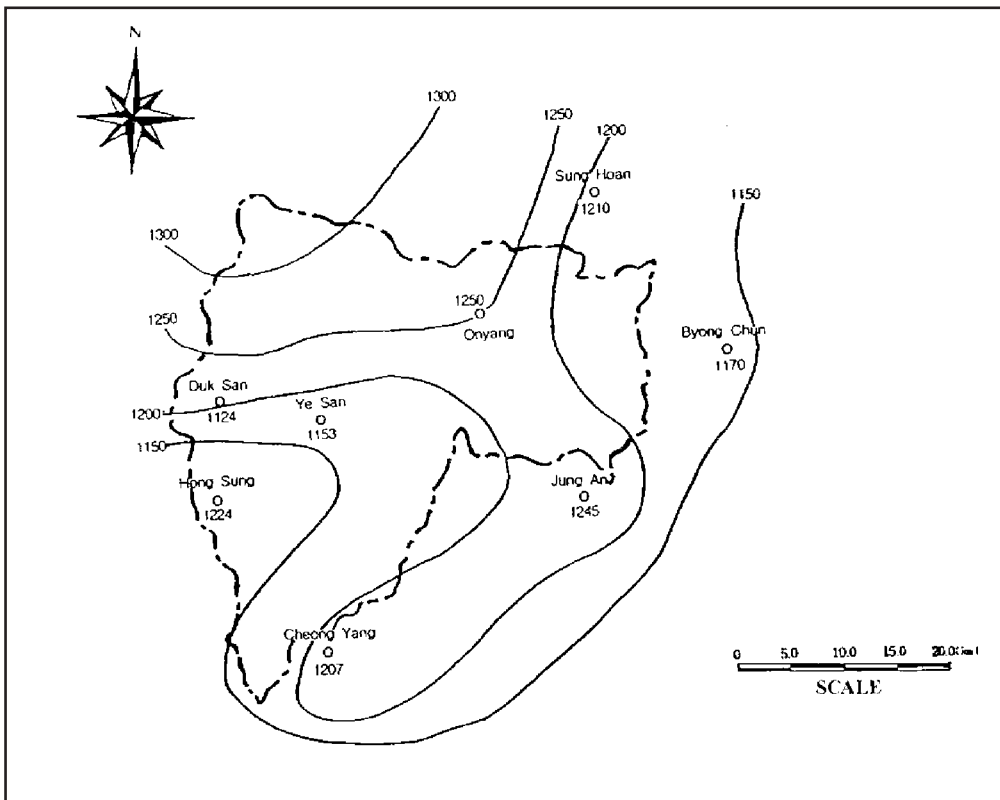
F: Forest L: Lake, river, marsh P: Paddy field U: Urban O: Orchard  
A: Agricultural field (vegetable field, grass field)

## 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 <sup>1)</sup> [mm]	Mean annual evaporation <sup>2)</sup>	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

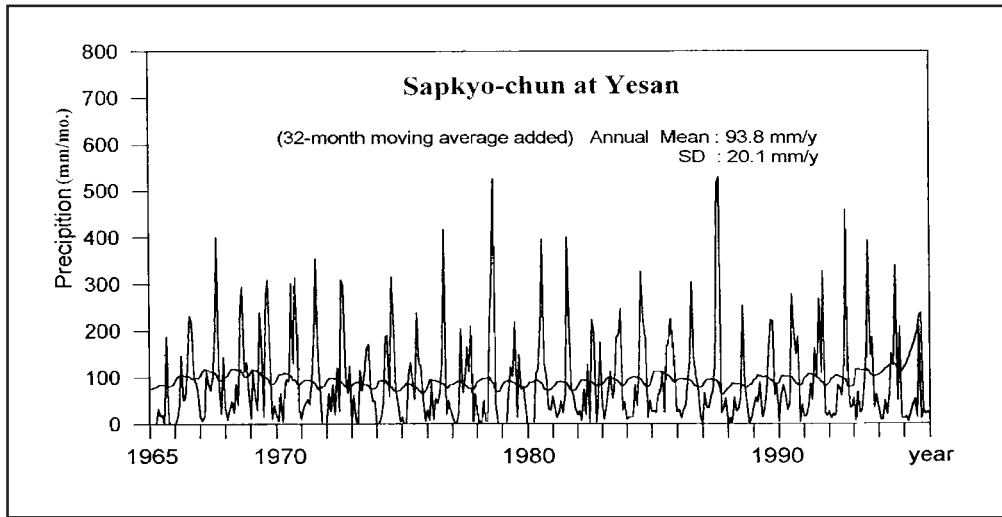
### 3.3 Monthly Climate Data

#### 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

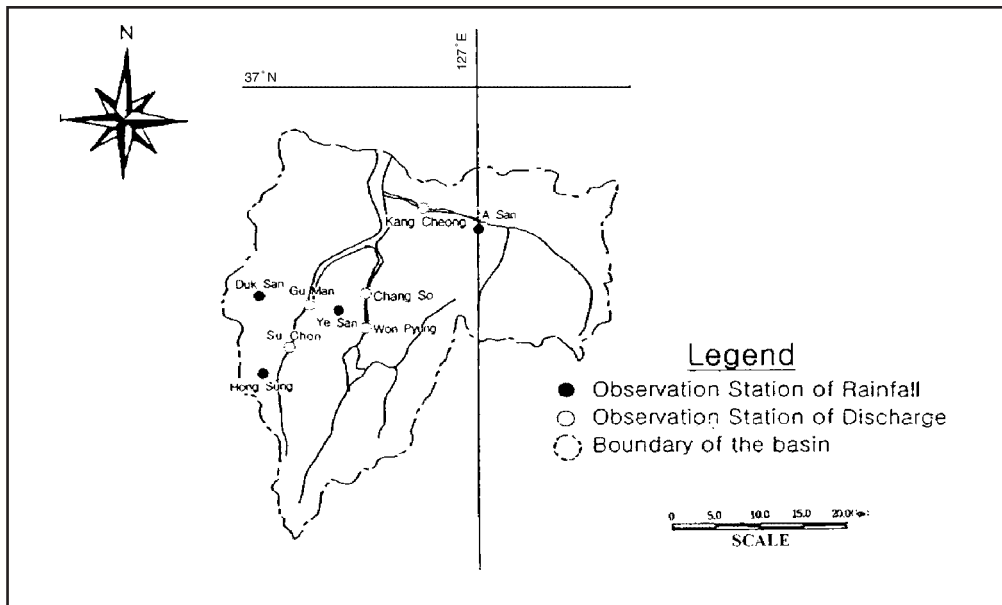
\*measured by 20 cm pan

### 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 <sup>2</sup> ]	Observation period	Observation items <sup>1)</sup> [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.*	$\bar{Q}$ <sup>2)</sup> [m <sup>3</sup> /s]	Qmax <sup>3)</sup> [m <sup>3</sup> /s]	$\bar{Q}$ max <sup>4)</sup> [m <sup>3</sup> /s]	$\bar{Q}$ min <sup>5)</sup> [m <sup>3</sup> /s]	$\bar{Q}/A$ [m <sup>3</sup> /s/100km <sup>2</sup> ]	Qmax/A [m <sup>3</sup> /s/100km <sup>2</sup> ]	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

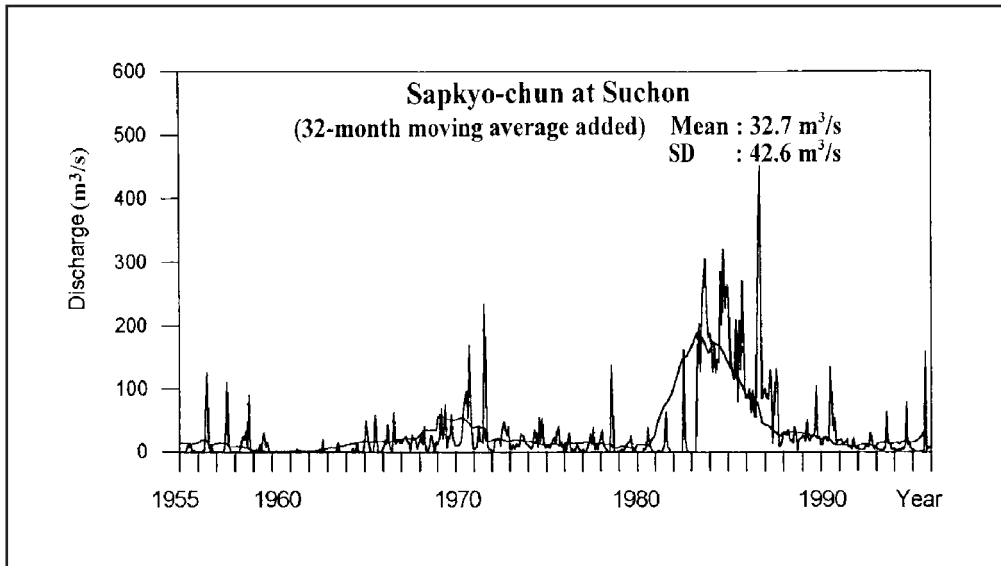
2) Mean annual discharge

3) Maximum discharge

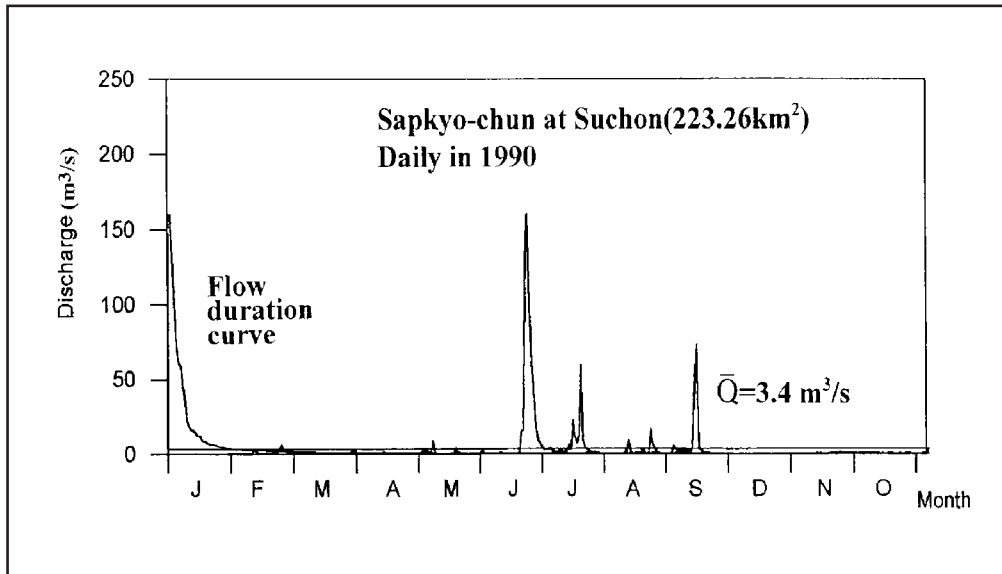
4) Mean annual maximum discharge

5) Mean annual minimum discharge

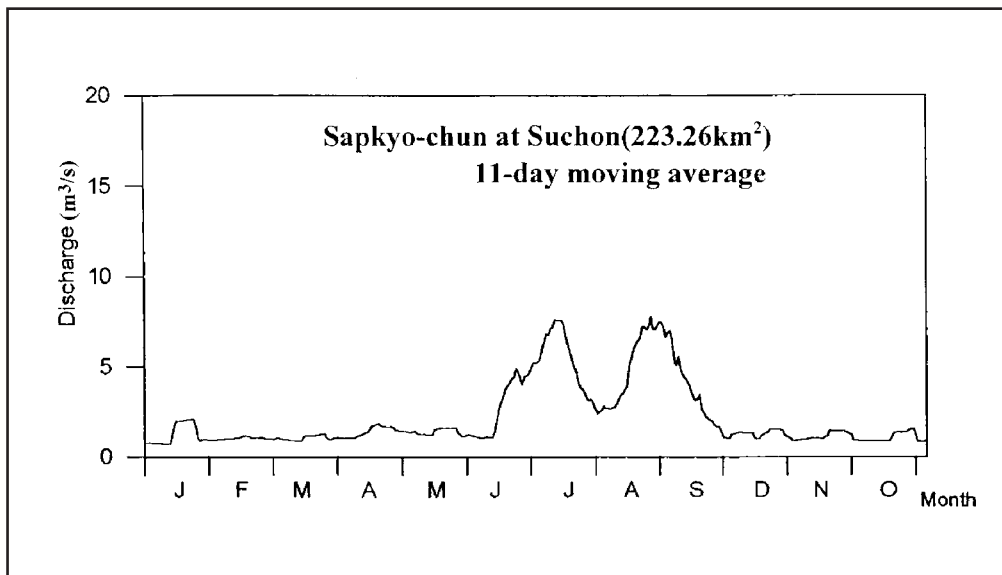
### 4.3 Long-term Variation of Monthly Discharge Series



#### 4.4 Annual Pattern of Discharge Series



#### 4.5 Unique Hydrological Features



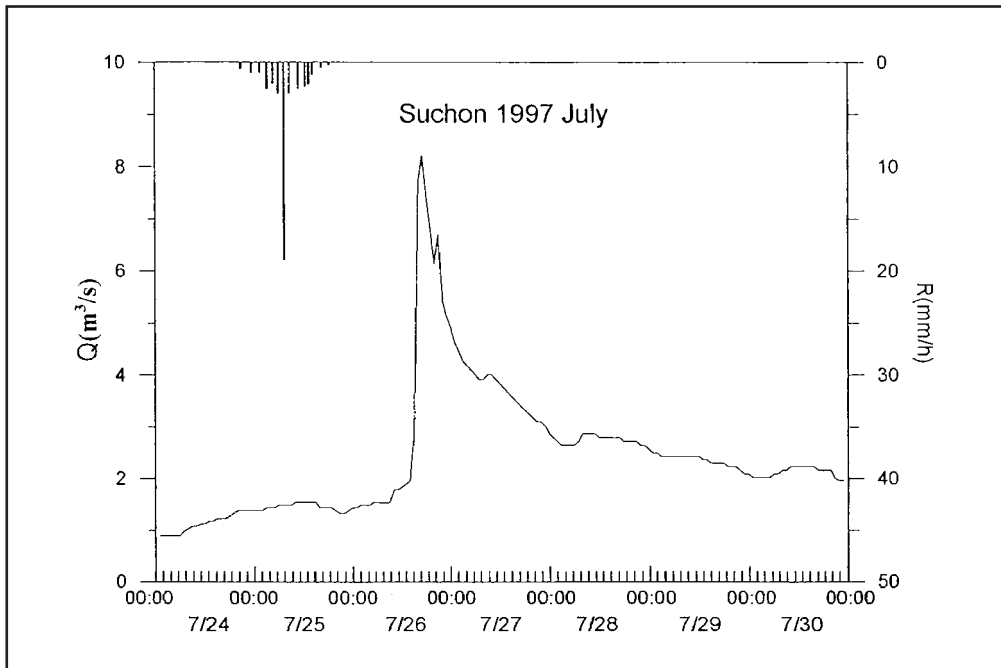
### 4.6 Annual Maximum and Minimum Discharges

Station: Suchon (223.26 km<sup>2</sup>)

Year	Maximum		Minimum		Year	Maximum		Minimum	
	Date	Discharge <sup>1)</sup> [m <sup>3</sup> /s]	Month	Discharge <sup>2)</sup> [m <sup>3</sup> /s]		Date	Discharge <sup>1)</sup> [m <sup>3</sup> /s]	Month	Discharge <sup>2)</sup> [m <sup>3</sup> /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

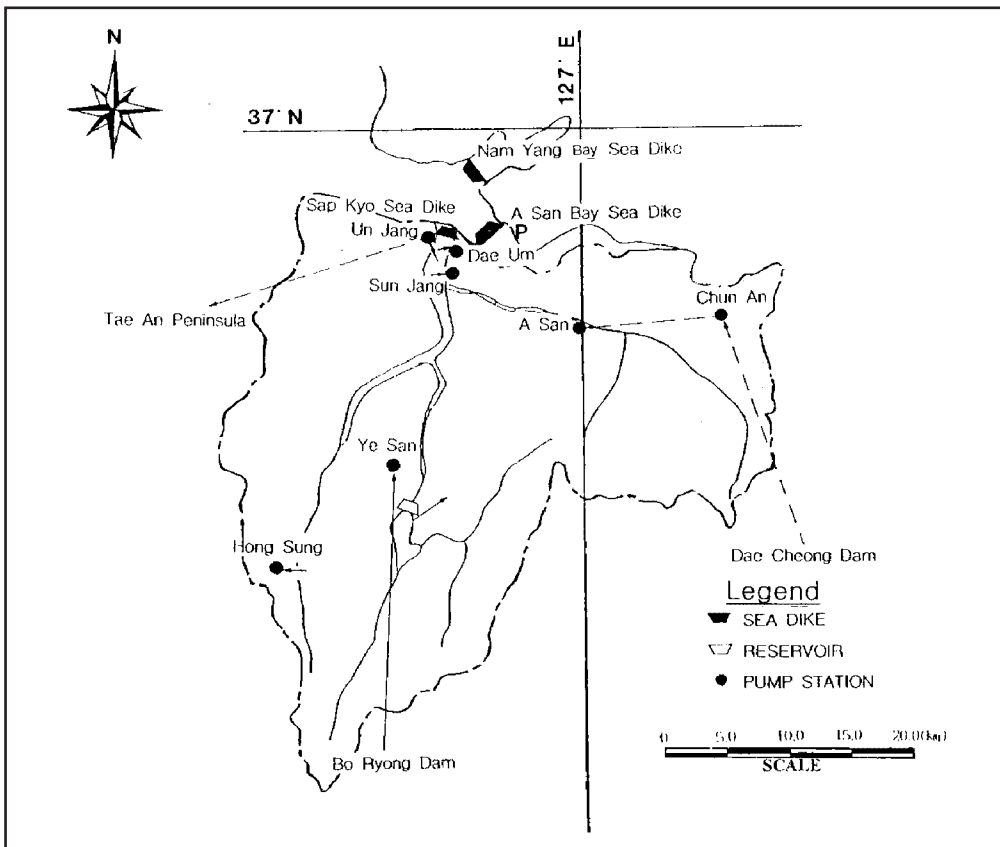
### 5.1 General Description

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 km<sup>2</sup> 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 m<sup>3</sup>/year and this has been supplied from outside the basin by the Daechong wide area water supply system. Of the 53,918 m<sup>3</sup>/day used by industry, 20,500 m<sup>3</sup>/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 m<sup>3</sup>/year and a further 52 million m<sup>3</sup>/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 m<sup>3</sup>/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 <sup>2</sup> ]	Gross capacity [10 <sup>6</sup> m <sup>3</sup> ]	Effective capacity [10 <sup>6</sup> m <sup>3</sup> ]	Purpose <sup>1)</sup>	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 <sup>3</sup> /s]	Purpose <sup>1)</sup>	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 <sup>3</sup> /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 Quality<sup>1)</sup> at Sapkyo-chun<sup>2)</sup>, 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 <sub>Mn</sub> [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] <sup>3)</sup>	900	1100	900	940	1100	1400	900	350	300	500	130	220
Discharge [m <sup>3</sup> /s] <sup>4)</sup>	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.

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Ministry of Construction and Transportation, Hydrological Annual Report of Korea, (3.2, 4.2, 4.3, 4.6, 4.7)

Ministry of Environment, Environmental Statistics Year Book, 1996 (5.5)

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