

# Soyang-gang

## Map of River



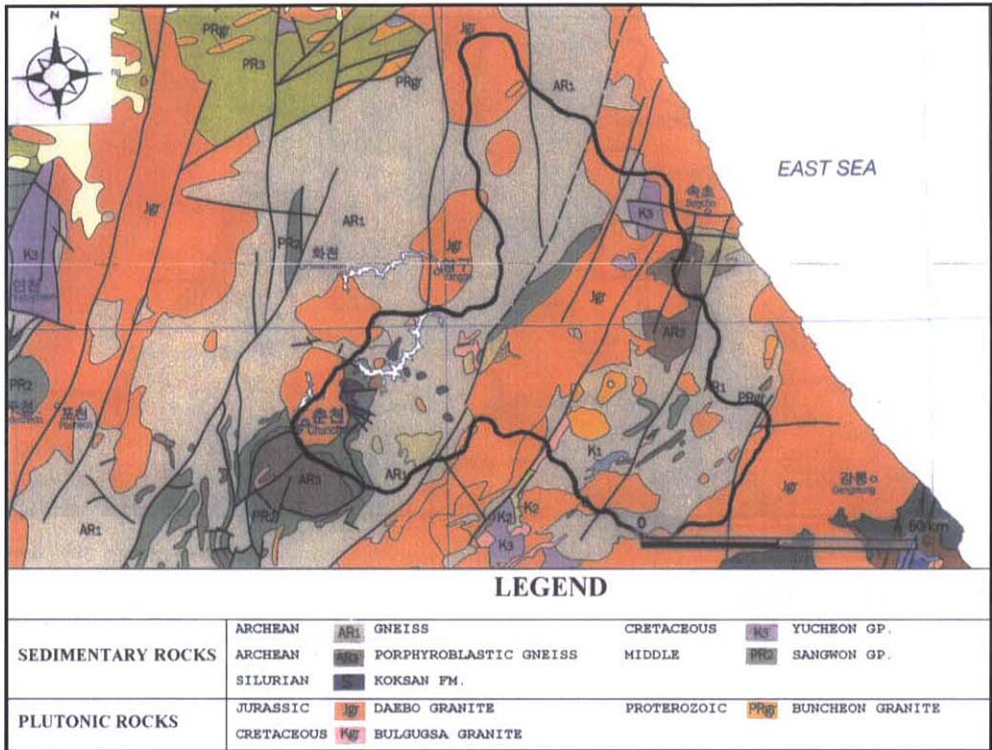
Geographical Survey, MOC, Korea

## Table of Basic Data

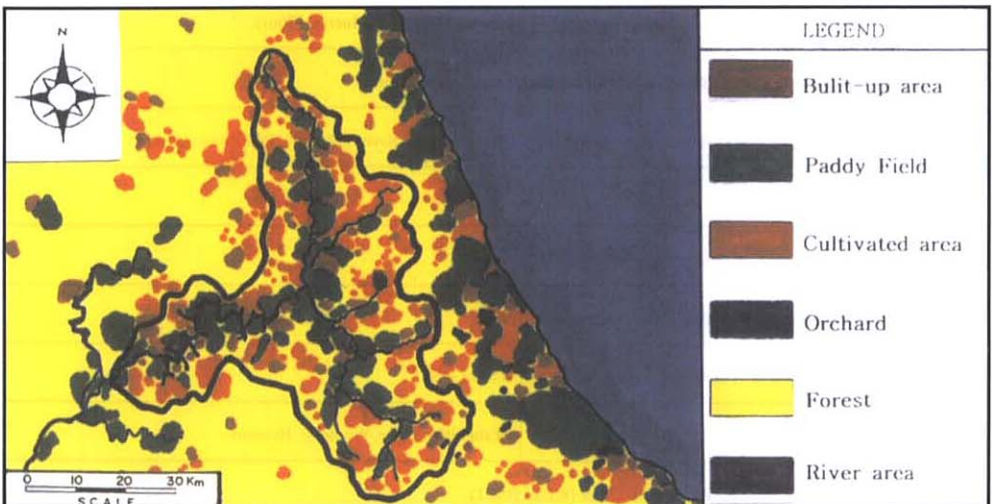
Name: Soyang River (in Han River)		Serial No. : Korea (R. of) - 4
Location : Kangwon province, Korea	N 37° 41' 07" ~ 38° 29' 50"	E 127° 47' 33" ~ 128° 35' 22"
Area : 2,886.6 km <sup>2</sup>	Length of main stream : 166.2 km	
Origin : Mt. Odae (1,563m)	Highest point : Mt. Odae (1,563m)	
Outlet : North Han River	Lowest point : Confluence (76m)	
Main geological features : Cretaceous Period; Gneiss, Crystalline Schist, Granite		
Main tributaries : Naelin River (1,045km <sup>3</sup> ), Bangdae River (196km <sup>3</sup> ), Inpuk River (746km <sup>3</sup> ), Puk River (178km <sup>3</sup> )		
Main lakes : None		
Main reservoirs : Soyang Reservoir (2.9×10 <sup>9</sup> m <sup>3</sup> , 1973)		
Mean annual precipitation : 1,107mm (1963 ~ 92) (basin average)		
Mean annual runoff : 68.0 m <sup>3</sup> /s at Soyang - gang (2,703km <sup>3</sup> ) (1974 ~ 93)		
Population : 52,100 (1991)	Main cities : Inje, Wontong, Hyeonri	
Land use : Forest (89.8%), Rice paddy ( 2.1%), Other (8.1%) (1991)		

## 2. Geographical Information

### 2.1 Geological Map



### 2.2 Land Use Map



## 1. General Description

The Soyang River originates from Mt. Odae (1,563m), in the northern high mountains of Korea (1,000~1,500m) and runs southward for about 60km. To the northeast of Inje which is the largest town in the upstream basin, the river joins with the tributaries of the Inpuk and Naelin Rivers. It then runs south-eastward for about 80km passing through the dam site and meets the North Han River to the north-east of Chunchon.

The Soyang has a catchment area of 2,887 km<sup>2</sup> and a length of about 166 km to the farthest point from the origin. The gradient of the river bed varies from 1/800~1/1,000 between the dam site and Inje, while being steeper in the upper reaches.

The average annual precipitation is 1,107mm over the basin and the average annual discharge at Soyang Gang dam (2,703km<sup>2</sup>) was 68.0m<sup>3</sup>/s (2.52 m<sup>3</sup>/s/100/km<sup>2</sup>) during 1974~1993. The population of the basin was 52,100 in 1991.

## 2.3 Characteristics of River and Main Tributaries

No.	Names of river	Length [km] Catchment area [km <sup>2</sup> ]	Highest Peak [m]	Cities (Population, 1985)	Land use (%) (1991)					
					F	L	P	O	A	U
1	Soyang (Main river)	166 2,886.6	Mt. Sorak 1,708	Inje-Gun : 37,500	89.8	2.4	2.1	1.3	4.2	0.2
2	Naelin (Tributary)	114 1,045.0	Mt. Kebang 1,577							
3	Bangdae (Tributary)	34 195.6	Mt. Karibong 1,519							
4	Inpuk (Tributary)	81 745.8	Mt. Maebong 1,358							
5	Puk (Tributary)	30 178.0	Mt. Sorak 1,708							

A: Agricultural field (vegetable field, grass field)  
O: Orchard

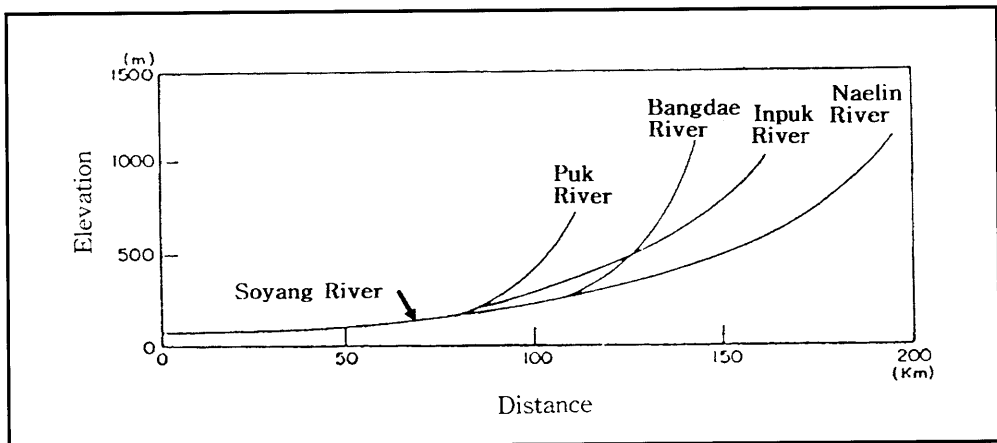
F: Forest

L: Lake, River, Marsh

P: Paddy Field

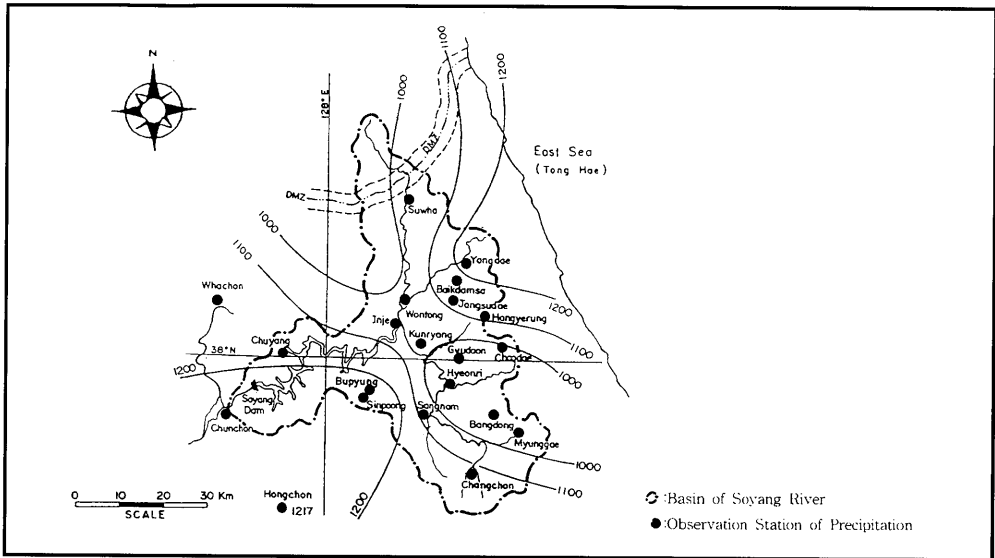
U: Urban

## 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***
101**	Chunchon	74	N 37° 54' E 127° 44'	1966 ~ present	1,296	1,074	P(TB) E, DS
211**	Inje	200	N 38° 03' E 128° 10'	1972 ~ present	1,092	1,114	P(TB) E, DS
46*	Bupyeong	250	N 37° 58' 00' E 128° 04' 50'	1962 ~ present	1,222		P(TB)
51*	Yongdae	380	N 38° 11' 35' E 128° 19' 55'	1964 ~ present	1,237		P(TB)
53*	Hwachon	154	N 37° 04' 00' E 127° 42' 35'	1916 ~ present	1,123		P(TB)
1*	Seohwa	480	N 38° 16' 32' E 128° 12' 54'	1972 ~ present	1,030		P(TB)
3*	Hyeonri	390	N 37° 57' 25' E 128° 19' 42'	1972 ~ present	913		P(TB)
4*	Changchon	690	N 37° 45' 21' E 128° 22' 49'	1972 ~ present	1,167		P(TB)

\*: Serial number used by Ministry of Construction

\*\* : Weather Office, Korean Meteorological Agency

\*\*\*: DS: Duration of sunshine, E: Evaporation, P: Precipitation, TB: Tipping bucket with recording chart

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

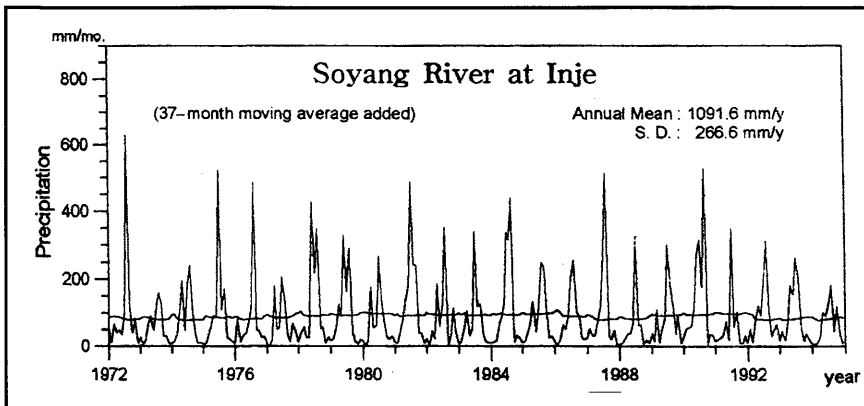
2) Measured by 20cm pan

### 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]	Inje	-5.6	-2.9	3.1	10.4	15.7	19.7	23.1	23.3	17.7	11.2	4.3	-2.3	9.8	1972-1990
Precipitation [mm]	Inje	14.7	19.7	28.9	72.5	85.2	124.7	258.6	243.7	141.4	36.1	35.6	20.5	1,091.6	1972-1990
Evaporation [mm]*	Inje	35.4	41.7	78.7	132.1	164.9	145.8	123.6	127.9	98.4	79.6	48.4	37.3	1,113.8	1972-1990
Solar radiation [MJ/m <sup>2</sup> /d]	Chuncheon	6.8	9.0	12.1	14.6	16.4	16.1	14.3	14.5	12.9	10.3	7.0	5.7	11.6	1972-1990
Duration of sunshine [hr]	Inje	175	175	217	229	261	237	202	206	195	190	148	157	2,392	1972-1990

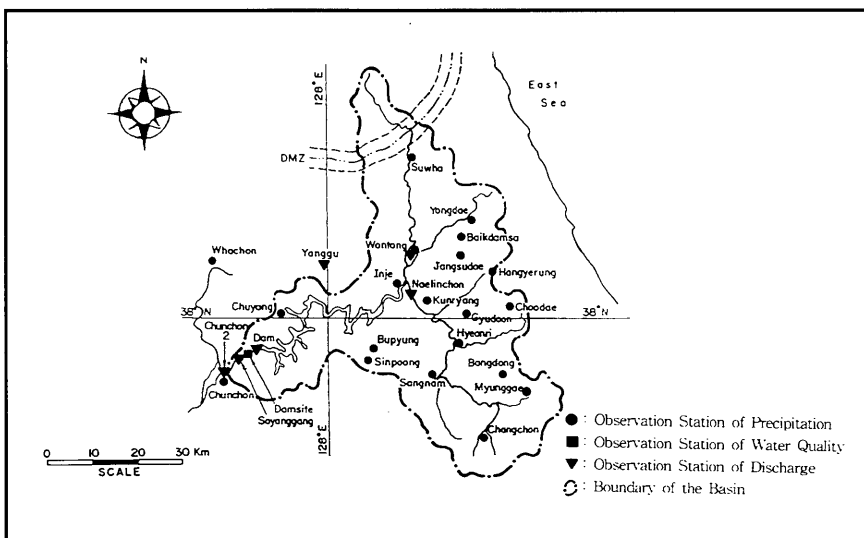
\*measured by 20cm pan

### 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**

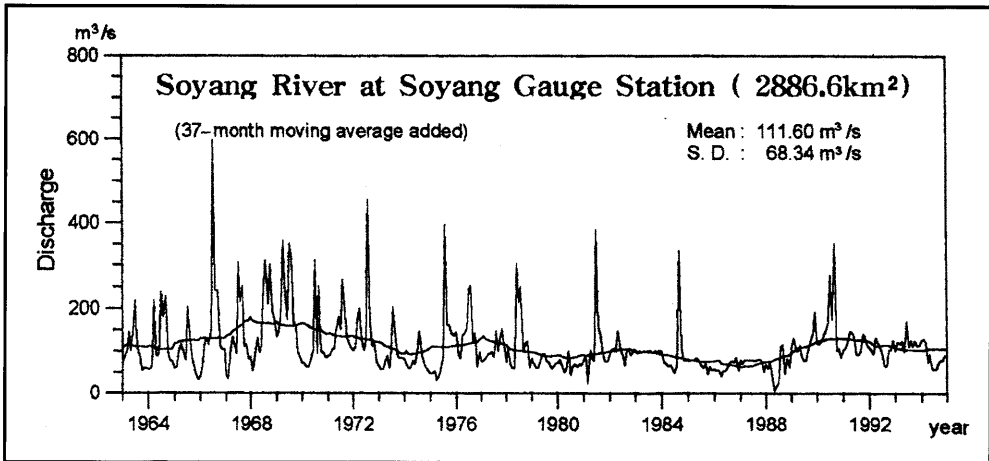
No.*	Station	Location	Catchment area(A) [km <sup>2</sup> ]	Observation period	Observation items
40*	Soyang	N 37' 55' 40' E 127' 47' 30'	2,886.6	1982~1993	H1
1**	Wontong	N 38' 07' 15' E 128' 11' 32'	546.0	1982~1993	H1
2**	Naelinchun	N 38' 02' 12' E 128' 12' 54'	1,045.0	1982~1993	H1

No.	$\bar{Q}$ <sup>1)</sup> [m <sup>3</sup> /s]	Q max <sup>2)</sup> [m <sup>3</sup> /s]	$\bar{Q}$ max <sup>3)</sup> [m <sup>3</sup> /s]	$\bar{Q}$ min <sup>4)</sup> [m <sup>3</sup> /s]	$\bar{Q} / A$ [m <sup>3</sup> /s/100 km <sup>2</sup> ]	Qmax / A [m <sup>3</sup> /s/100 km <sup>2</sup> ]	Period of statistics
40*	116.6	8,371	1,910	33.7	3.9	2.099	1963~1994

\*: Serial number used by Ministry of Construction  
 \*\*: Serial number used by Korea Water Resources Corporation  
 H1 : water level in recording chart

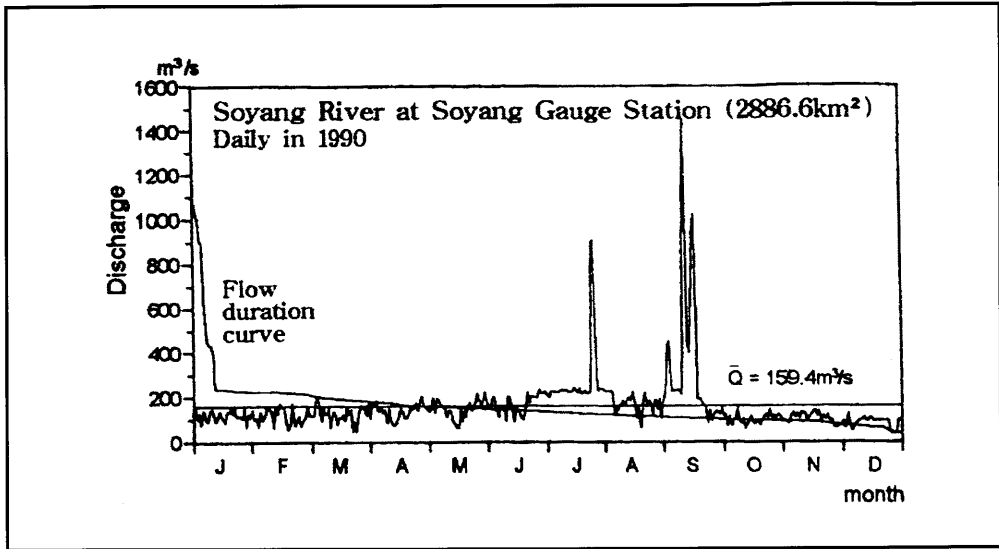
1) Mean annual discharge  
 2) Maximum discharge  
 3) Mean annual maximum discharge  
 4) Mean annual minimum discharge

**4.3 Long-term Variation of Monthly Discharge**

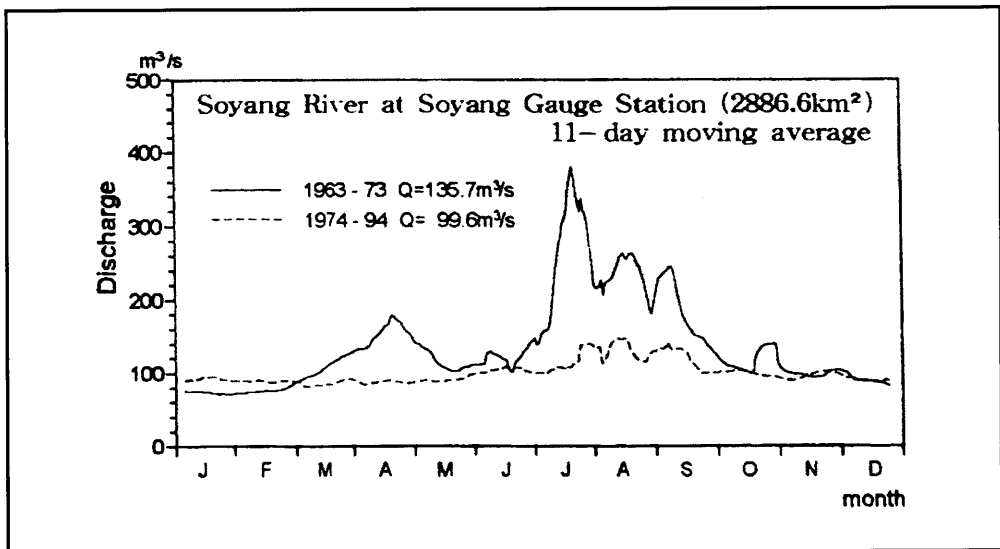


Note the large variation and change of annual flow pattern since 1974 after the Soyang - gang Dam Construction.

4.4 Annual Pattern of Discharge



4.5 Unique Hydrological Features



Note that the Soyang gang Dam was constructed in 1973.

### 4.6 Annual Maximum and Minimum Discharges

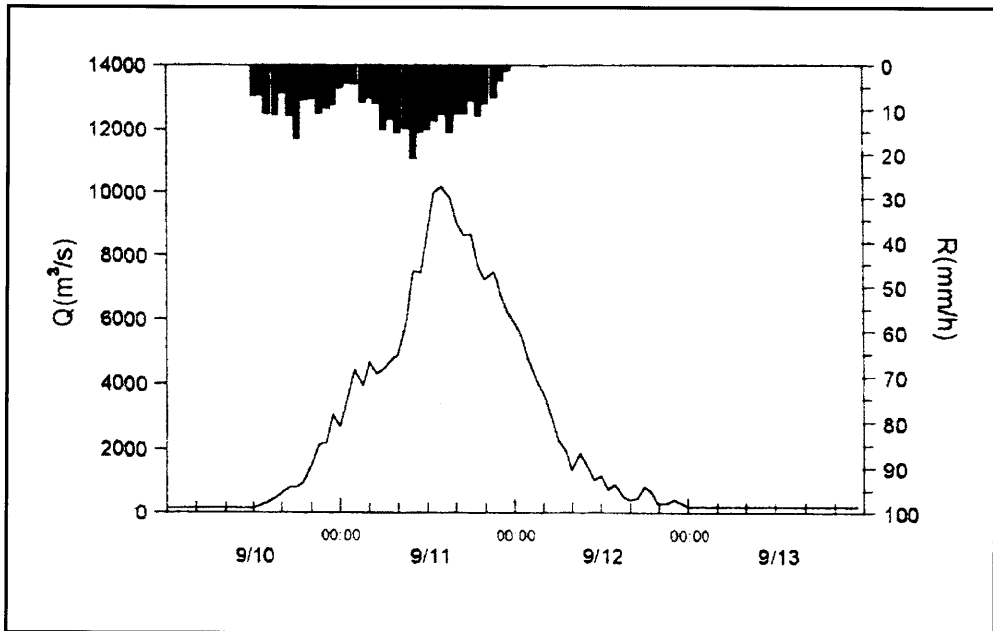
At Soyang Gang (2,703 km<sup>2</sup>)

Year	Maximum <sup>1)</sup>		Minimum <sup>2)</sup>		Year	Maximum <sup>1)</sup>		Minimum <sup>2)</sup>	
	Date	[m <sup>3</sup> /s]	Month	[m <sup>3</sup> /s]		Date	[m <sup>3</sup> /s]	Month	[m <sup>3</sup> /s]
1963	7.25	2,590	5	46.2	1979	6.27	561	3	23.7
1964	8.12	2,600	1	54.3	1980	4.06	408	2	23.7
1965	7.16	8,250	12	28.0	1981	7.12	1,166	1	23.7
1966	7.26	5,420	1	20.3	1982	8.27	1,161	1	39.6
1967	7.20	1,350	2	14.9	1983	7.25	487	1	36.1
1968	10.25	2,760	2	47.2	1984	9.02	5,398	5	31.1
1969	4.24	1,532	11	46.2	1985	10.13	412	11	9.5
1970	7.23	1,494	3	39.6	1986	8.29	543	4	10.4
1971	6.12	1,958	2	77.5	1987	7.16	1,037	12	36.1
1972	8.19	8,371	12	39.6	1988	7.13	430	5	2.7
1973	9.01	785	2	53.3	1989	7.26	296	11	42.4
1974	7.09	429	3	23.7	1990	9.12	5,675	12	37.9
1975	7.16	1,053	4	23.7	1991	7.25	282	1	37.9
1976	8.13	2,322	3	39.6	1992	8.07	352	2	39.6
1977	7.09	241	2	35.3	1993	6.25	416	5	32.8
1978	6.26	1,094	1	23.7	1994	10.30	252	4	37.9

1), 2) Instantaneous observation by recording chart

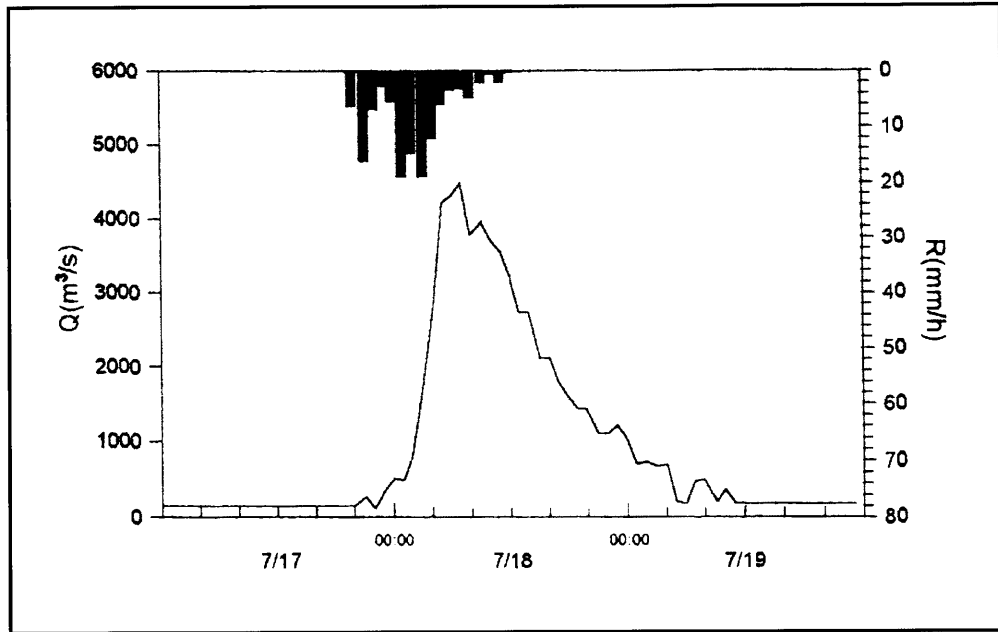
### 4.7 Hyetographs and Hydrographs of Major Floods

At Soyang Gang Dam (2,703 km<sup>2</sup>) July 1990





At Soyang Gang Dam (2,703 km<sup>2</sup>) September 1990



Based on the data of Ministry of Construction and Transportation  
Hyetographs of basin average rainfall

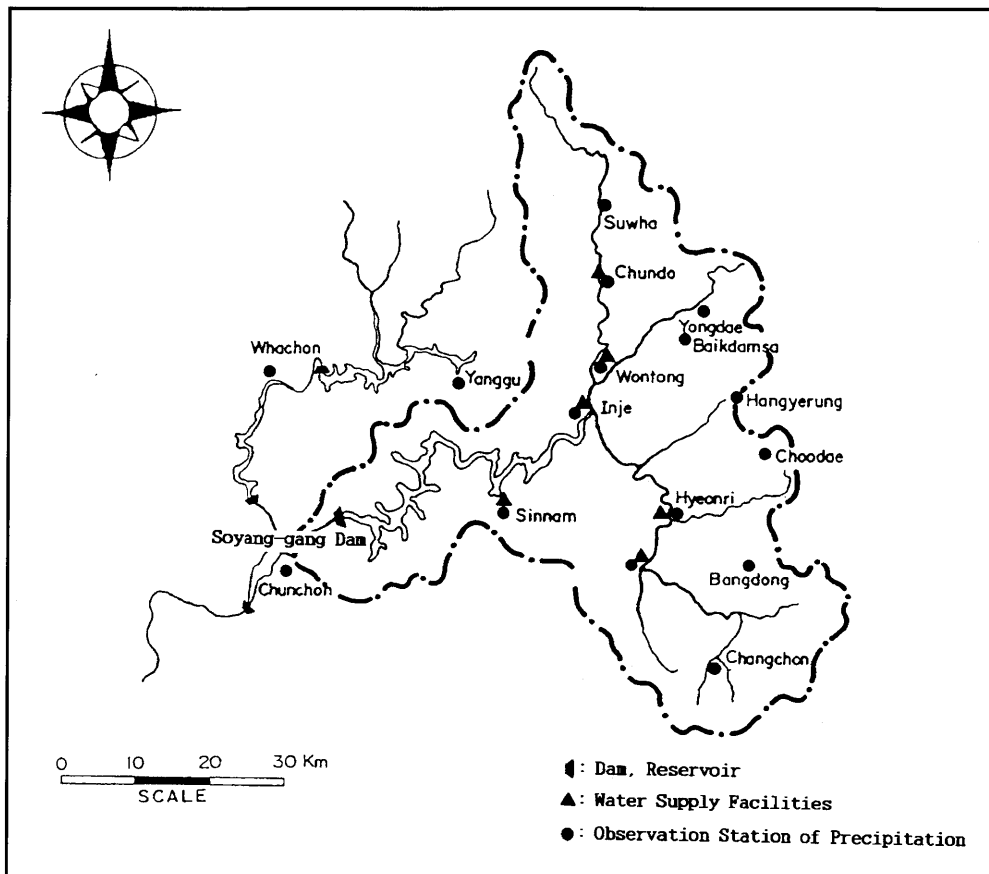
## 5. Water Resources

### 5.1 General Description

The Soyang River is the largest tributary of the North Han River which together with the South Han River constitutes the Han River. Except for some narrow flat areas between valleys, most of the basin consists of mountainous areas covered by shallow well-drained soil layers.

The site of the Soyang Gang multi-purpose dam which is a zone-fill dam, is situated about 80 km east of the capital Seoul and about 13 km northeast of Chunchon. The dam which is 123 m high with a crest length of 530 m, has a large reservoir with a gross storage capacity of  $2.9 \times 10^9$  m<sup>3</sup>, an active storage capacity of  $1.9 \times 10^9$  m<sup>3</sup>, a flood control volume of  $0.5 \times 10^9$  m<sup>3</sup>, a reservoir area of 70 km<sup>2</sup>, and an annual energy output of  $353 \times 10^6$  kWh. It contributes to the reduction of flood damages in downstream areas including the capital Seoul, the supply of water for municipal, industrial and irrigation purposes, and the accommodation of the peak demand in the electric supply network.

## 5.2 Map of Water Resources 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
Soyang River	Soyang Gang Dam	2,703	2,900	1,900	W, I, N	1973

1)I: Industrial use, N: Maintenance of normal flows, W: Municipal water supply

## Major Inter-basin Transfer

Name of transfer line	Names of rivers and places connected		Length [km]	Maximum capacity [m <sup>3</sup> /s]	Purpose <sup>1)</sup>	Year of completion
	From	To				
Inje conveyance pipe	Naelinchun	Inje	2.6	0.024	W	N.A.
Sinnam conveyance pipe	Woogakchun	Sinnam	1.8	0.017	W	N.A.
Wontong conveyance pipe	Pukchun	Wontong	0	0.023	W	N.A.
Hyeonri conveyance pipe	Bangdaechun	Hyeonri	0.9	0.017	W	N.A.
Chundo conveyance pipe	Inpukchun	Chundo	1.4	0.012	W	N.A.
Sangnam conveyance pipe	Sangnamchun	Sangnam	0.5	0.006	W	N.A.
Yanggu-kun conveyance channel	Soyang River	Yanggu-kun	total <sup>2)</sup> 68	0.29	A	N.A.
Inje-kun conveyance channel	Soyang River	Inje-kun	total <sup>2)</sup> 534	0.26	A	N.A.

1) A : Agricultural use, W: Municipal water supply

2) There are many channels with short lengths

## 5.4 Major Floods and Droughts

Major Floods at Soyang-gang (Catchment area 2,703 km<sup>2</sup>)

Date	Peak discharge [m <sup>3</sup> /s]	Rainfall [mm] Duration	Meteorological cause	Dead and missing	Major damages (Districts affected)
1972.8.19	8,371	429.1 8.18~8.19	Typhoon	3	Hyeonri
1984.9.02	5,398	457.4 8.31~9.03	Typhoon	2	Yongdae
1990.9.10	5,675	509.7 9.09~9.10	Typhoon	1	Changchan

## Major Droughts

Period	Affected areas	Major damages and counteractions
1982. 8 ~ 10	Hyeonri	Supply cut ratio at the first stage: 7%
1994. 7 ~ 9	Hyeonri	Supply cut ratio at the first stage: 5%

## 5.5 Groundwater and River Water Quality

### River Water Quality<sup>1)</sup> at Soyang-gang<sup>2)</sup>, 1994

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pH	7.1	7.2	7.2	7.3	6.9	7.1	7.1	7.1	9.2	7.1	7.2	7.2
BOD [mg/l]	0.9	1.0	1.1	1.4	1.4	1.4	1.3	1.4	0.5	1.0	0.9	0.5
COD <sub>Mn</sub> [mg/l]	1.4	1.2	1.2	1.8	1.6	1.8	1.9	1.5	2.0	1.6	1.4	2.5
SS [mg/l]	1.9	2.0	1.8	2.3	2.8	2.5	1.9	1.5	2.0	1.5	0.8	0.6
Coliform Group [MPN/100ml] <sup>3)</sup>	1.7×10 <sup>2</sup>	1.7×10 <sup>2</sup>	1.4×10 <sup>2</sup>	1.4×10 <sup>2</sup>	0.9×10 <sup>2</sup>	0.9×10 <sup>2</sup>	1.7×10 <sup>2</sup>	5.0×10 <sup>2</sup>	7.0×10 <sup>2</sup>	5.0×10 <sup>2</sup>	9.6×10 <sup>2</sup>	2.0×10 <sup>2</sup>
Discharge [m <sup>3</sup> /s] <sup>4)</sup>	107.6	116.7	100.3	115.2	131.1	90.6	104.7	106.2	97.5	91.9	94.7	86.5

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

2) Located near Yongwol City 14 km from the river mouth.

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

4) Discharge on the observation date.

## 6. Socio-cultural Characteristics

Inje is the largest town in this basin. The Demilitarised Zone (DMZ) is located in the northern part of this area. The East Sea (Tong Hae) is located about 60 km east of Inje. This region of Korea has many beautiful beaches. There are also three beautiful National Parks : Kumgangsan to the north of this area, Soraksan to the east, and Odaesan to the south-east. In addition, there is Jinburyung ski resort to the north-east.

## 7. References, Databooks and Bibliography

- Agriculture and Fisheries Development Corporation, (1987): *List of Hydrological Facilities (5-1)*. (2.2)
- Geological Survey of Korea, (1973): *Geological Atlas of Korea (1/250,000)*. (2.1) (in Korean)
- Han River Flood Control Instrument, *Stage Self Record Papers, 1973~1994*. (4.3, 4.4, 4.5, 4.6, 4.7)
- Korea Institute of Energy and Resources, (1985): *Precise Geological Surveying of Soyang Area*. (2.1, 2.3, 2.4) (in Korean)
- Korean Meteorological Agency, *Annual Climatological Report, 1990/1992*. (3.1, 3.2, 3.3, 3.4) (in Korean)
- Korea Water Resources Corporation, (1995): *Evaluation to Dam Operation and Hydrological Design of Soyang Gang Multi-Purpose Dam*. (4.1, 4.2, 5.2) (in Korean)
- Korean Water Resources Corporation, (1992): *Hydrological Stability Analysis of Existing Soyang Gang Multipurpose Dam project*. (4.1, 4.2, 5.2) (in Korean)
- Korea Water Resources Development Corporation, (1969): *Soyang Gang Multi-Purpose Dam Project, Volume 1, Design Report*. (1.1)
- Kwangwon-Do, (1987): *Basic Planning for the Maintenance of Soyang River*. (5.1) (in Korean)
- Ministry of Environment, (1995): *Annual Report of Water Quality Observation*. (5.5) (in Korean)
- Ministry of Construction, *Annual Report of Hydrological Data, 1963~1994*. (4.3, 4.4, 4.5, 4.6, 4.7) (in Korean)
- Ministry of Construction, *Flood in Korea, 1973 - 1994*. (5.4) (in Korean)