Banbyeon Chun

Map of River

Geographical Survey, MOCT Korea

Table of Basic data

Name(s): Banbyeon River (in Nakdong River)		**Serial No. :** Korea (R. of) -13
Location: Kyongbuk Province, Korea	E 128° 59' 09" ~ 129° 18' 05"	N 36° 34' 11" ~ 36° 52' 42"
Area: 1,932.1 km^2	**Length of the main stream:** 100.70 km	
Origin: Mt. Ilwol (1,218.5 m)	**Highest Pt. :** Mt. Ilwol (1,218.5 m)	
Outlet: Nakdong River	**Lowest Pt. :** River mouth (86.20 m)	
Main base rocks: Jurassic Period; Debo granite , Cretaceous Period ; Ponghwasan GP.		
Main tributaries: Dong stream (145.8 km^2), Yongjun stream (503.21 km^2), Kilan stream (515.2 km^2)		
Main lakes: None		
Main reservoirs: Imha Dam (595 × 10^{6}m^3, 1992)		
Mean annual precip. : 956.95 mm (1966 ~ 1996) (basin average)		
Mean annual runoff: 57.16 m^3/sec		
Population: 73,679	**Main cities:** Chongsong, Yongyang	
Land use: Forest (78.2%), Rice Paddy (12.3%), Urban (1.3%), Others (8.2%) (1990)		

1. General Description

The Banbyeon River is one of the main tributaries of the Nakdong river flowing through the north-eastern part of the Republic of Korea. The catchment area is 1,932.1 km^2 and the river is 100.7 km long, originating from Mt. Ilwol (1,218.5 m). The average annual precipitation is 956.95 mm and the average annual runoff at Imha (1,361.0 km^2) is 57.16 m^3/sec. In 1992 the population in the basin was 73,679. Imha multiple dam having a storage volume of 595×10^6 m^3 was constructed in 1992. The basin consists of a relatively mountainous area upstream and a well developed plain downstream around Imha Dam. The urban areas are Chongsong and Yongyang located in the north-eastern part of Korea.

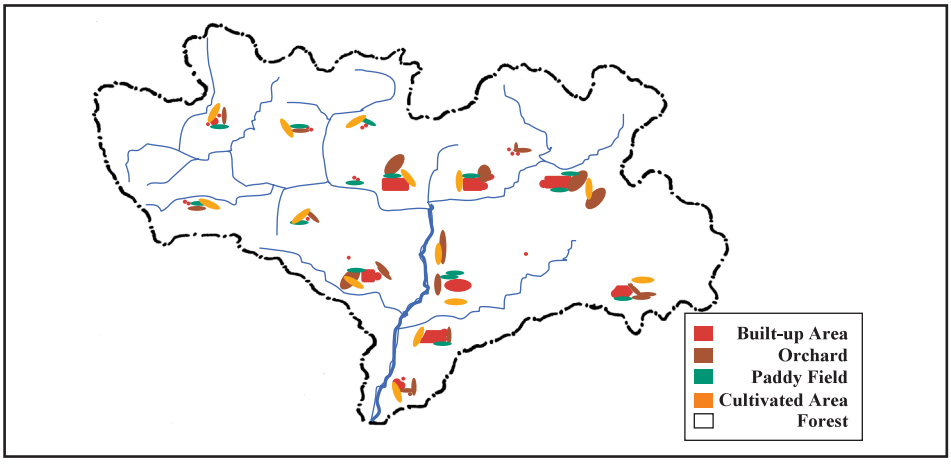
2. Geographical Information

2.1 Geological Map

LEGEND

SEDIMENTARY ROCK		VOLCANIC ROCK	PLUTONIC ROCK
MESOZOIC	K2 HAYANG GP	K3 JAEDOK GP	Kgr AMNOKGANG COMP
	FUCHEON GP	PONGHWASAN GP	Jgr DAEBO GRANITE
			Jgr1 FOLIATED GRANITE
PALEOZOIC			PALgr NAMGANG COMP
			O GREAT LIMESTOM GP

2.2 Land Use Map

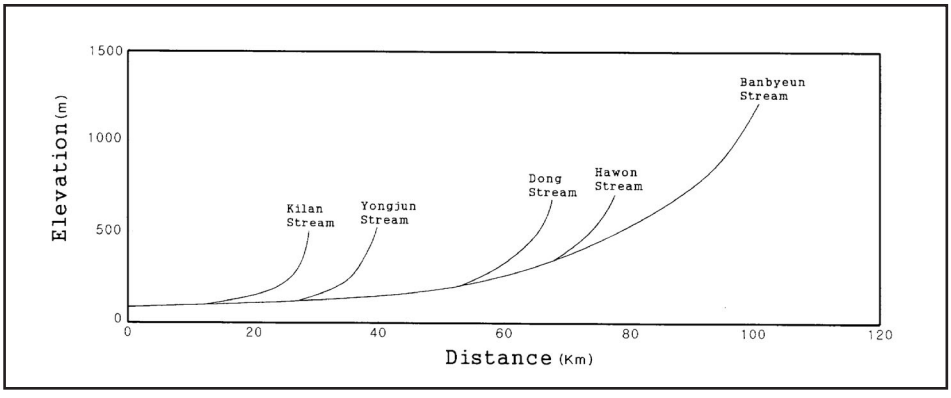


2.3 Characteristics of the River and the Main Tributaries

No	Names of River	Length Catchment Area	Highest Peak	Cities Population ('92)	Land use (%)					
					F	L	P	O	A	U
1	**Banbyeon** (Main Stream)	100.72 km 932.10 km^2	Mt. Ilwol 1,218.5 m	Choungsong 56,745	78.2	1.3	12.3	0.8	7.7	1.3
2	**Dong stream** (Tributary)	35.20 km 145.38 km^2	Mt. Ilwol 1,218.5 m	Yongyang 16,934						
3	**Hawon stream** (Tributary)	24.0 km 126.58 km^2	Mt. Ilwol 1,218.5 m							
4	**Yongjun stream** (Tributary)	56.20 km 503.21 km^2	Mt. Dalureung 743 m							
5	**Kilan stream** (Tributary)	75.0 km 478.0 km^2	Mt. Meunbong 1,113m							

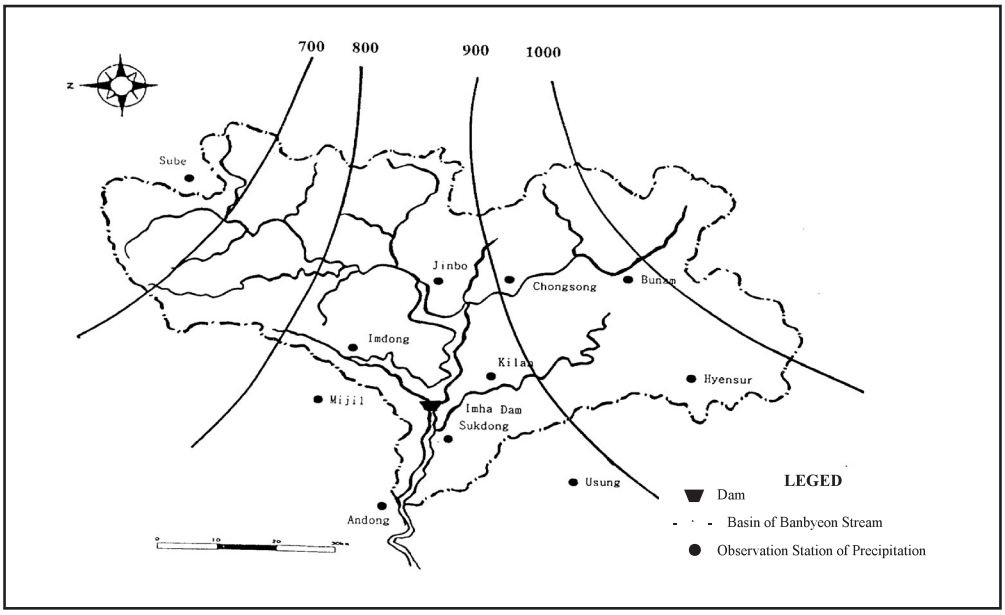
F: Forest L: Lake, River, marsh P: Paddy Field U: Urban
O: Orchard A: Agricultural field (vegetable field, grass field)

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyetal Map and Observation Stations



Based on the data of Ministry of Construction & 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
210*	**Imdong**	130	N 36° 33' 50" E 128° 55' 50"	1969 ~ present	754.5	-	P (TB)
211*	**Jinbo**	160	N 36° 31' 35" E 129° 02' 50"	1969 ~ present	710.3	-	P (TB)
148*	**Hyeunseo**	555	N 36° 15' 157" E 128° 55' 00"	1961 ~ present	810.0	-	P (TB)
147*	**Kilan**	120	N 36° 25' 46" E 128° 54' 57"	1964 ~ present	727.3	-	P (TB)
15**	**Eusung**	73	N 36° 21' E 128° 41' 42"	1971 ~ present	805.6	1,200.3	P (TB) E, DS
60**	**Andong**	139.3	N 36° 33' 00" E 128° 43' 00"	1982 ~ present	887.2	1,175.1	P (TB) E, DS
63**	**Yongduk**	40.5	N 36° 32' 00" E 129° 52' 00"	1971 ~ present	927.5	1,131.0	P (TB) E, DS

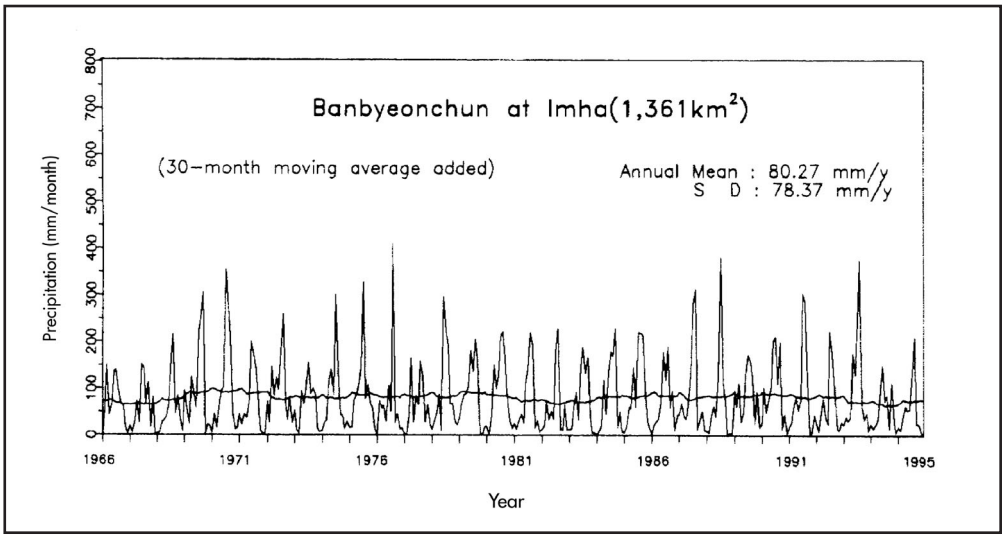
* : Serial number used by Ministry of Construction and transportation
** : Weather Office, Korea Meteorological Agency
P: Precipitation, E: Evaporation, DS: Duration of sunshine, TB: Tipping bucket with recording chart
1) Period for the mean is from the beginning of the observation period to 1992.
2) Measured by 20 cm pan.

3.3 Monthly Climate Data

	Observation Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for The mean
Temperature (°C)	**Eusung**	-4.1	-7	4.4	11.5	16.5	21.4	24.3	25.2	18.9	12.6	4.8	-1.3	10.6	1961 ~ 1990
Precipitation (mm)	**Eusung**	19.2	28.1	43.1	77.9	67.8	134.6	205.3	179.1	118.9	43.6	36.2	1,818	971.8	1961 ~ 1990
Evaporation (mm)*	**Eusung**	60.1	67.2	100.6	126.9	159.9	146.3	134.4	138.6	105.6	88.8	61.6	56.7	1,100.9	1961 ~ 1990
Solar radiation ($MJ/m^2/day$)	**Eusung**	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Duration of sunshine (hr)	**Eusung**	228.7	220.2	266.8	268.5	311.1	288.1	266.8	281.8	256.2	253.5	211	224.2	3,076.9	1961 ~ 990

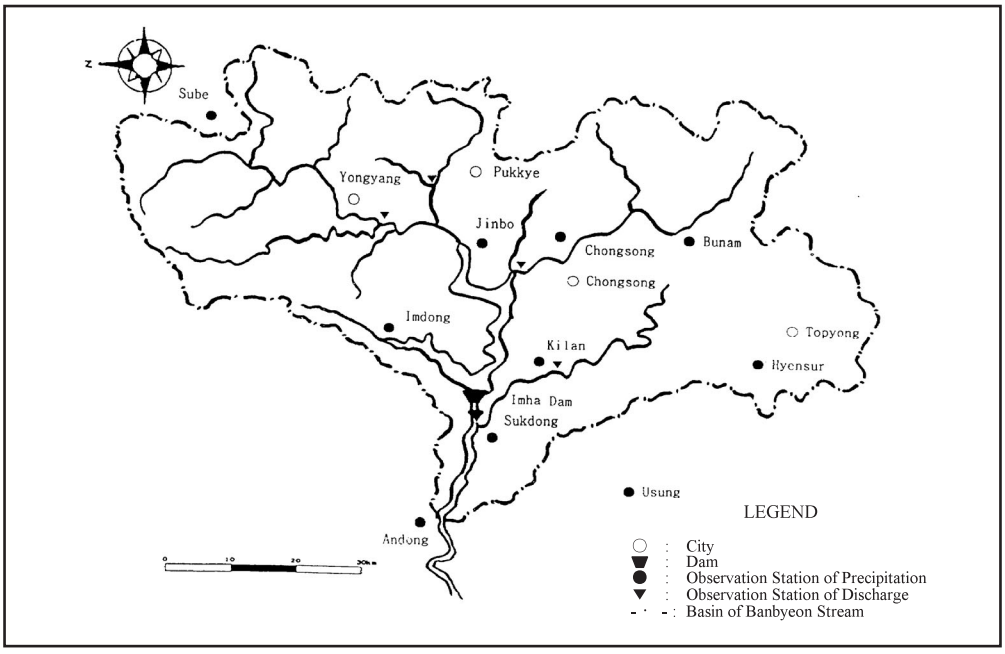
* measured by 20 cm pan

3.4 Long-term Variation of Monthly Precipitation Series



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



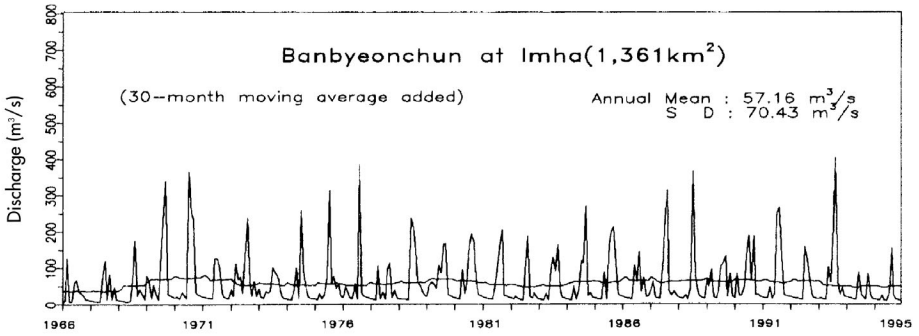
4.2 List of Hydrological Observation Stations

No.*	Station	Location	Catchment area (A) (km^2)	Observation Period	Observation Items[1)]
42*	**Kilan**	N 36° 25' 46" E 128° 54' 57"	478	1968 ~ present	H1
40*	**Yongyang**	N 36° 39' 01" E 129° 06' 29"	236	1987 ~ present	H1
129*	**Imha**	N 36° 31' 57" E 128° 50' 54"	1,361	1987 ~ present	H1
60*	**Chongsong**	N 37° 07' 28" E 129° 00' 31"	211.8	1987 ~ present	H1

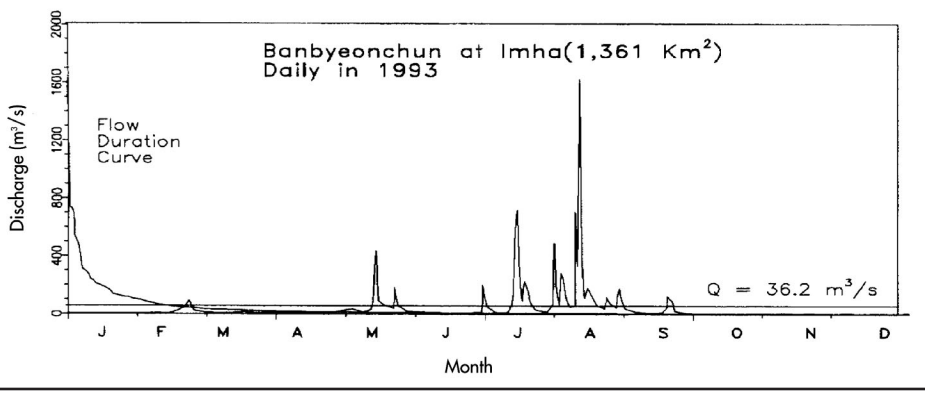
No.	$\overline{Q}$[2)] (m^3/s)	Qmax[3)] (m^3/s)	$\overline{Q}$max[4)] (m^3/s)	$\overline{Q}$min[5)] (m^3/s)	$\overline{Q}$/A ($m^3/s/100km^2$)	Qmax/A ($m^3/s/100km^2$)	Period of Statistics
129*	57.16	2,262.5	890.1	1.39	4.20	166.24	1987 ~ present

*: Serial number used by Ministry of Construction
1) H1: water level in recording chart, H2: water level by manual
Q: discharge
2) Mean annual discharge
3) Maximum discharge
4) Mean maximum discharge
5) Mean minimum discharge

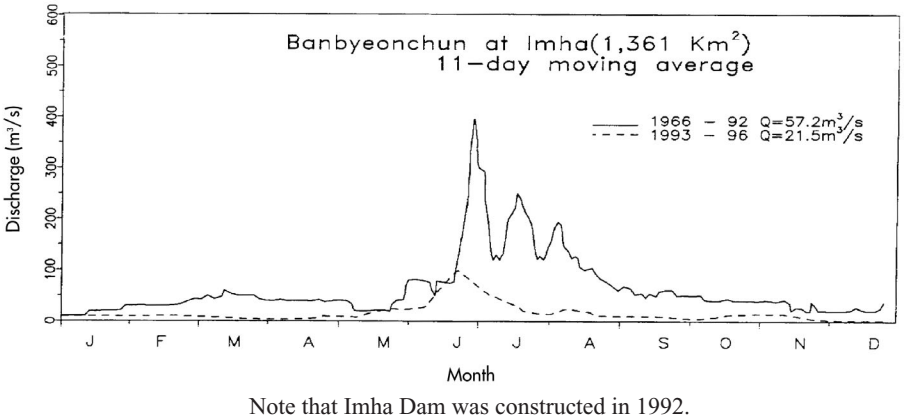
4.3 Long-term Variation of Monthly Discharge Series



4.4 Annual Pattern of Discharge Series



4.5 Unique Hydrological Features



Note that Imha Dam was constructed in 1992.

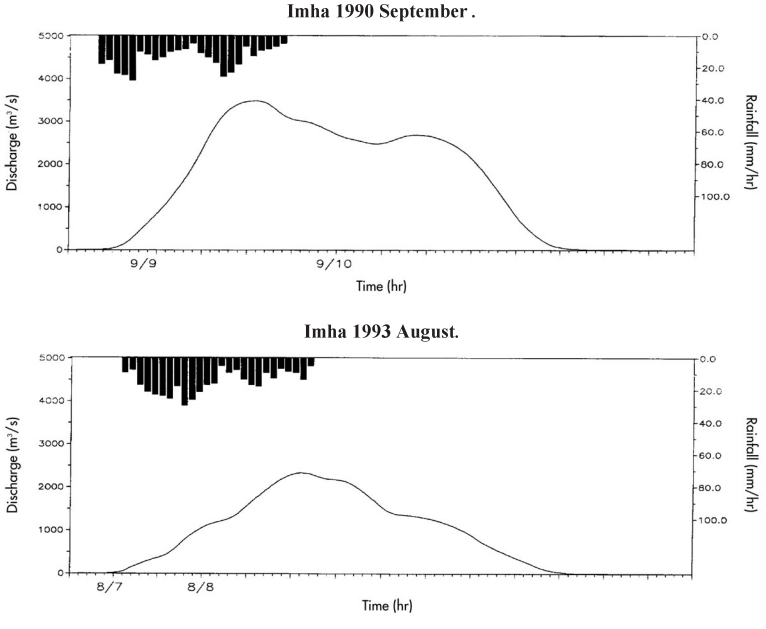
4.6 Annual Maximum and Minimum Discharges

At Imha Dam (1,361 km^2)

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)
1966	6.18	874.3	2	3.2	**1982**	8.14	1,526.2	2	1.2
1967	7.25	678.7	4	2.1	**1983**	8.16	811.8	12	1.1
1968	8.14	790.6	11	1.6	**1984**	7.08	904.5	1	0.7
1969	9.06	113.6	12	2.2	**1985**	7.16	316.9	2	0.3
1970	7.23	865.0	1	3.0	**1986**	6.24	609.7	2	0.9
1971	8.18	476.5	4	2.1	**1987**	7.16	396.5	3	1.1
1972	6.26	698.7	11	1.2	**1988**	7.26	274.8	2	0.9
1973	9.01	240.7	2	4.6	**1989**	7.29	1,318.1	1	1.9
1974	5.19	708.6	1	1.1	**1990**	6.20	711.0	12	0.7
1975	9.17	596.7	12	0.8	**1991**	8.23	1,266.0	1	0.8
1976	6.09	1,316.9	11	1.2	**1992**	9.24	1,096.7	2	0.9
1977	7.28	369.4	1	1.1	**1993**	8.10	1,640.9	10	0.9
1978	6.18	2,011.1	1	0.9	**1994**	7.01	308.3	12	0.7
1979	8.25	2,262.5	1	0.7	**1995**	8.31	467.0	10	0.3
1980	9.10	1,211.4	1	3.1	**1996**	6.25	887.4	12	0.2
1981	8.30	790.6	11	2.4	**1997**	7.18	1,042.5	1	0.6

1), 2) Instantaneous observation by recording chart

4.7 Hyetographs and Hydrographs of Major Floods



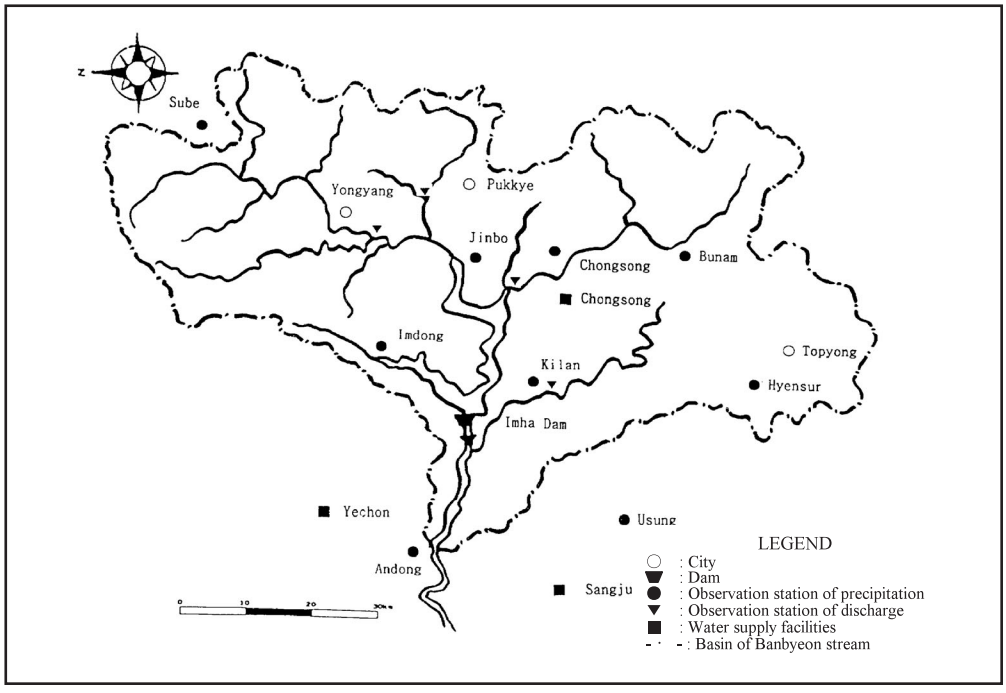
Based on the data of Ministry of Construction and Transportation

5. Water Resources

5.1 General Description

The Banbyeon River with an area of 1,932.1 km^2 consists of a mountainous area upstream and a plain area downstream. The agricultural and forest areas in the basin occupy about 12.3% and 78.2% of the total area respectively. The runoff in the dry season is very small even though floods often occur in the rainy season. To meet the water demand, a reservoir known as Imha was constructed. At present, almost all drinking water needs in the large cities which are located in the upstream area of the basin are supplied from the reservoir.

5.2 Map of Water Resource Systems



5.3 List of Major Water Resources Facilities

Major Reservoirs

Name of stream	Name of dam	Catchment Area (km^2)	Gross Capacity (10^6m^3)	Effective Capacity (10^6m^3)	Purposes[1)]	Year of Completion
Banbyeon (main)	Imha	1,361	595	424	W, A, I	1992

Major Interbasin Transfer

Name of Transfer line	Names of rivers Connected		Length (km)	Maximum Capacity (m^3/s)	Purposes[1)]	Year of Completion
	From	To				
Yongchon spillway	Imha	Sangju	65.3	0.34	W, I, A	1993
Yongchon spillway	Imha	Yechon	42.1	0.024	W, I, A	1993
Yongchon spillway	Imha	Chongsong	18.5	0.011	W, I, A	1993
Yongchon spillway	Imha	Dosan	23.3	0.081	W, I, A	1993

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

5.4 Major Flood and Drought Experiences

Major Floods (Catchment area 1,932.1 km^2)

Date	Peak Discharge (m^3/s)	Rainfall (mm) Duration Period	Meteorological Cause	Dead And Missing	Major damages (Districts affected)
1970.7.21	1,950.00	424 7.21 ~ 22	Storm	19	Imdong, Imha
1987.7.21	7,510.26	344 7.21 ~ 23	Storm	1 -	Ilwol, Yongyang
1988.7.13	1,945.82	180 7.13 ~ 15	Storm	- -	Hyeonsea
1987.9.9	1,296.98	54 9.10 ~ 11	Storm	- -	Jinbo, Sekbo
1995.8.29	2,862.00	184 9.30	Storm	- -	Kilan

Major Droughts

Period	Areas Affected	Major damages and counteractions
1977, Jan. ~ Jul.	Yongyang, Jinbo, Chongsong	Damage the crops of 10%
1981 ~ 1982	Jinbo, chongsong, Kilan	Supply cut ratio at the first stage: 10%
1981, May ~ Sept.	Imdong, Jinbo, Chongsong	Supply cut ratio at the first stage: 10%
1987 ~ 1988	Kilan, Imha, Hyensea	Damage the crops of 10%
1994 ~ 1995	Andong, Imdong, Imha	Supply cut ratio at the first stage: 25%

5.5 Groundwater and Water Quality

River Water Quality[1] at Banbyeon stream[2], 1996

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pH	7.4	7.4	7.7	7.6	7.4	7.5	7.4	7.7	6.9	7.2	7.4	7.8
BOD (mg/I)	0.9	0.9	1.1	0.8	0.8	0.6	0.7	1.2	0.9	0.9	1.0	1.1
COD_{Mn} (mg/I)	3.5	2.7	3.0	1.7	2.7	2.1	2.9	3.1	3.3	2.8	2.9	3.2
SS (mg/I)	2.0	1.6	2.6	1.4	1.5	1.7	1.3	1.5	1.7	2.2	2.0	1.6
Coliform Group [Mpn/100ml]m[3]	2.4×10^2	4.7×10^2	4.3×10^2	4.5×10^2	4.5×10^2	5.1×10^2	2.7×10^2	1.6×10^2	1.7×10^2	183	660	907
Discharge (m^3/s)[4]	29.35	25.55	26.36	24.54	32.82	67.14	52.34	110.31	90.16	36.83	7.85	18.94

1) Observed once a month on a dry day normally several days after rainfall.
2) Located near Andong City 14㎞ from Imha Dam.
3) Measurement method: BGLB (brilliant green lactose bile) method.
4) Discharge on the observation date.

6. Socio-cultural Characteristics

The Banbyeon River is one of the most upper reaches of Nakdong River, and is located in the north-eastern part of the Korean peninsular. It contains the two cities of Chongsong gun and Yongyang gun where there are very beautiful mountainous areas with clean water and fresh air. Chongsong gun contains the Juwangsan National Park and many ancient temples, so it is one of the most famous sightseeing sites. Yongyang gun has also a very beautiful mountainous area where the natural environment is unpolluted and old villages are maintained. These two cities are the most natural regions of Kyongbuk province, famous for mineral water which has a very unique taste and hot-springs.

7. References, Data books and Bibliography

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