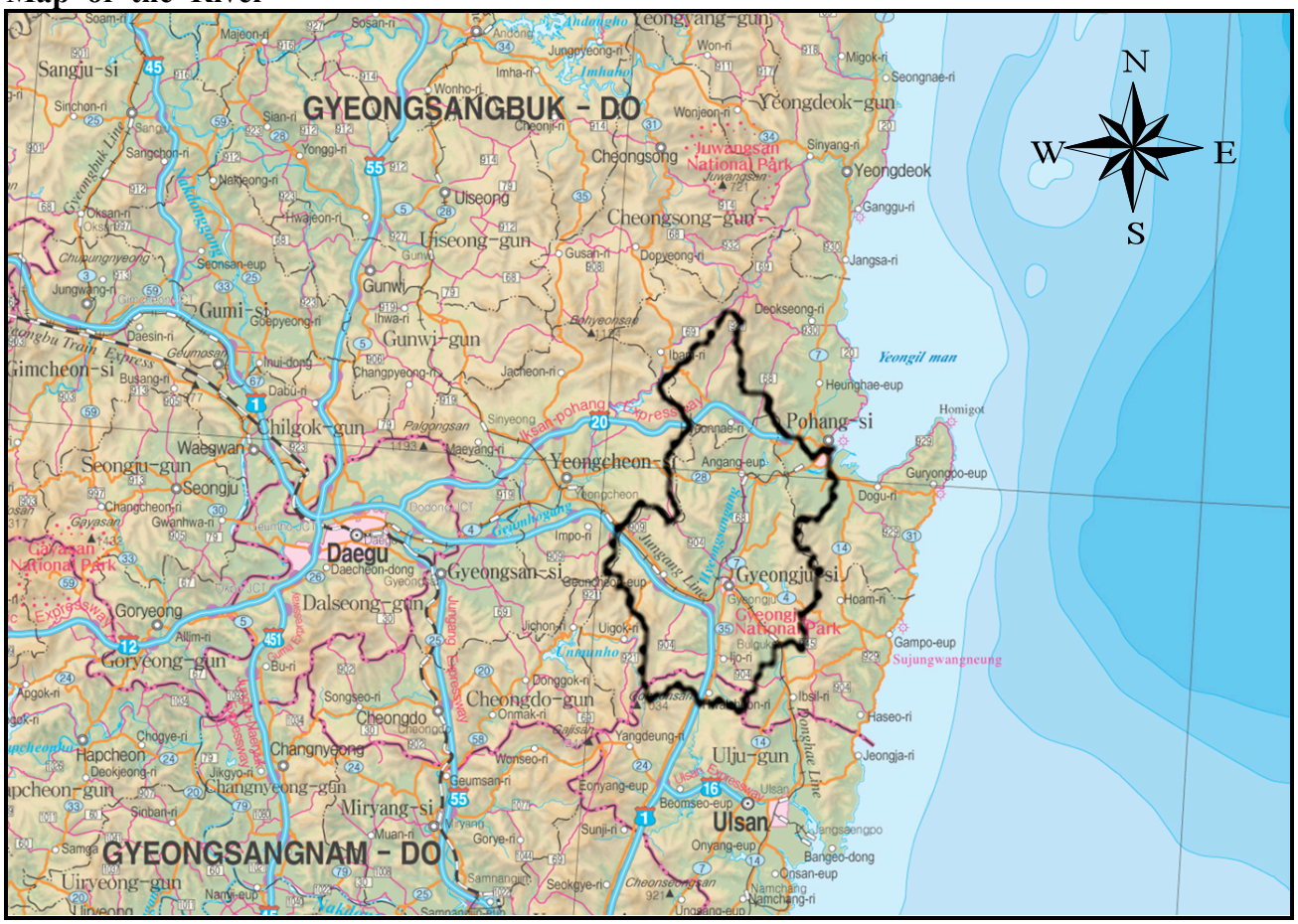
HYEONGSAN GANG

Map of the River



Geographical Survey, MOCT Korea

Table of Basic data

Name(s) : Hyeongsan River		**Serial No.**: Korea (R. of) – 20
Location : Gyeongbuk Province, Korea	**N 35° 40′ 00″ ~ 36°12′00′**	**E 129° 01′ 00″ ~ 129°25′00″**
Area : 1,166.80 km^2	**Length of the main stream :** 62.1 km	
Origin : Mt. Beakwoon (901m)	**Highest point.** : Mt. Beakwoon (901m)	
Outlet : East Sea	**Lowest point. :** River mouth (6m)	
Main base rocks : Bulguksa Granite, Sedimentary Rocks, Hayang Group, Yucheon Group		
Main tributaries : Dae Stream (160.40km^2), Gigye Stream (199.20km^2)		
Main lakes : Bomoonho(98.34×10^{4}m^3)		
Main reservoirs : Deokdong Dam (32.7×10^{6}m^3)		
Mean annual precipitation : 1,120mm (1949 ~ present) at Pohang		
Mean annual runoff : 18.3 m^3/sec (1966 ~ present) at Pohang		
Population : 374,937 (2005)	**Main cities :** Gyeongju, Pohang	

Land use : Forest (69.1%), Paddy(12.3%), Agricultural Field(6.0%) Urban(6.2%), Others(6.4%) (2000)

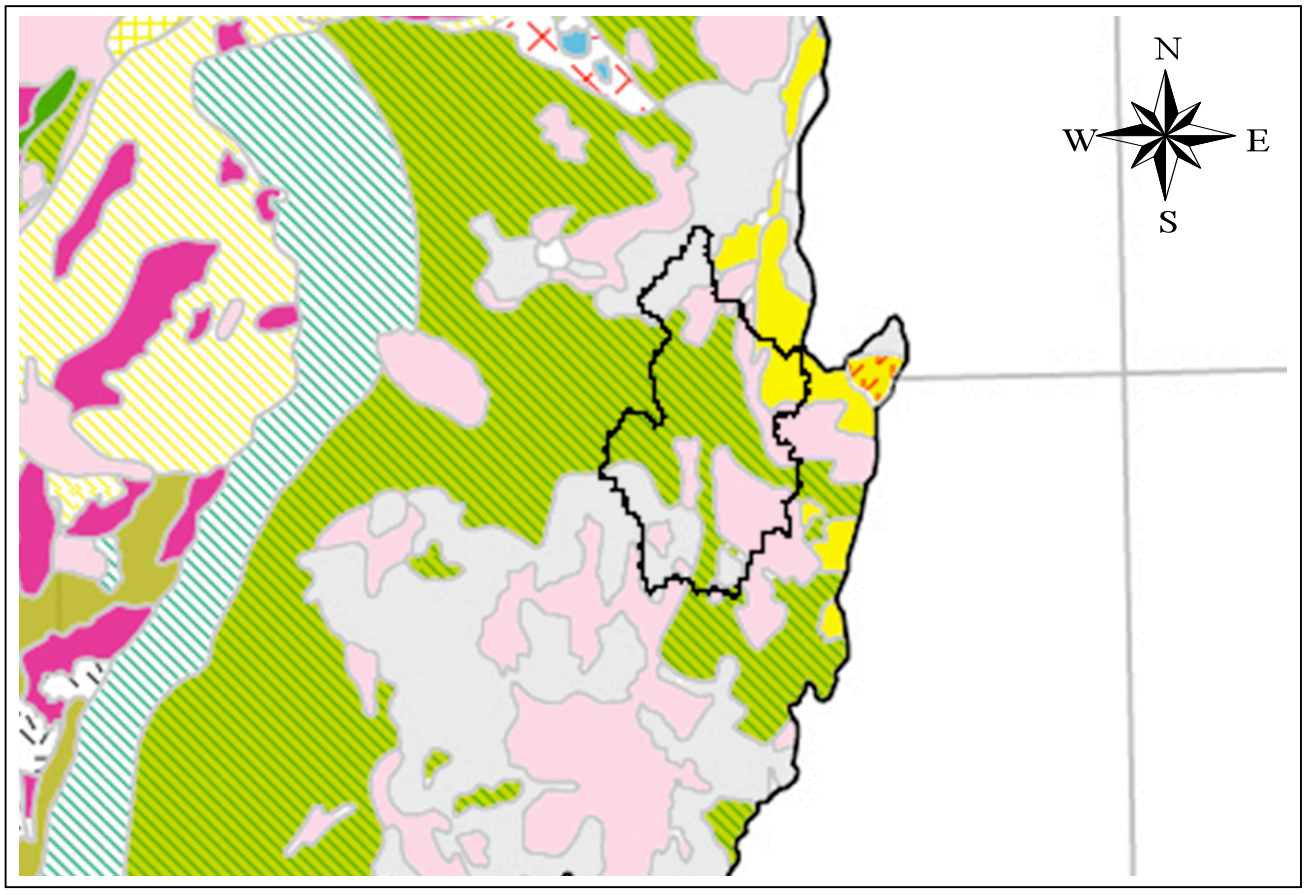
1. General Description

1.1 General Description

The Hyeongsan river is flowing through the south-estern part of Gyeongbuk Province, Korea. The catchment area is 1,166.80km^2 and 62.1km long, originate from Mt. Beakwoon(901.0 m). The average annual precipitation is 1,117mm over the basin and the average annual runoff is 18.3m^3/sec. In 2005, the population in the basin are 374,937 people. Deokdong dam having the storage volume that is 32.7×10^{6}m^3 for agricultural water supply was constructed in 1986. The basin consists of the upper stream that is mountainous area and the lower stream that is the well developed area. There are urban cities such as Gyeongju and Pohang which are placed in south-eastern part of Gyeongbuk Province, Korea.

2. Geographical Information

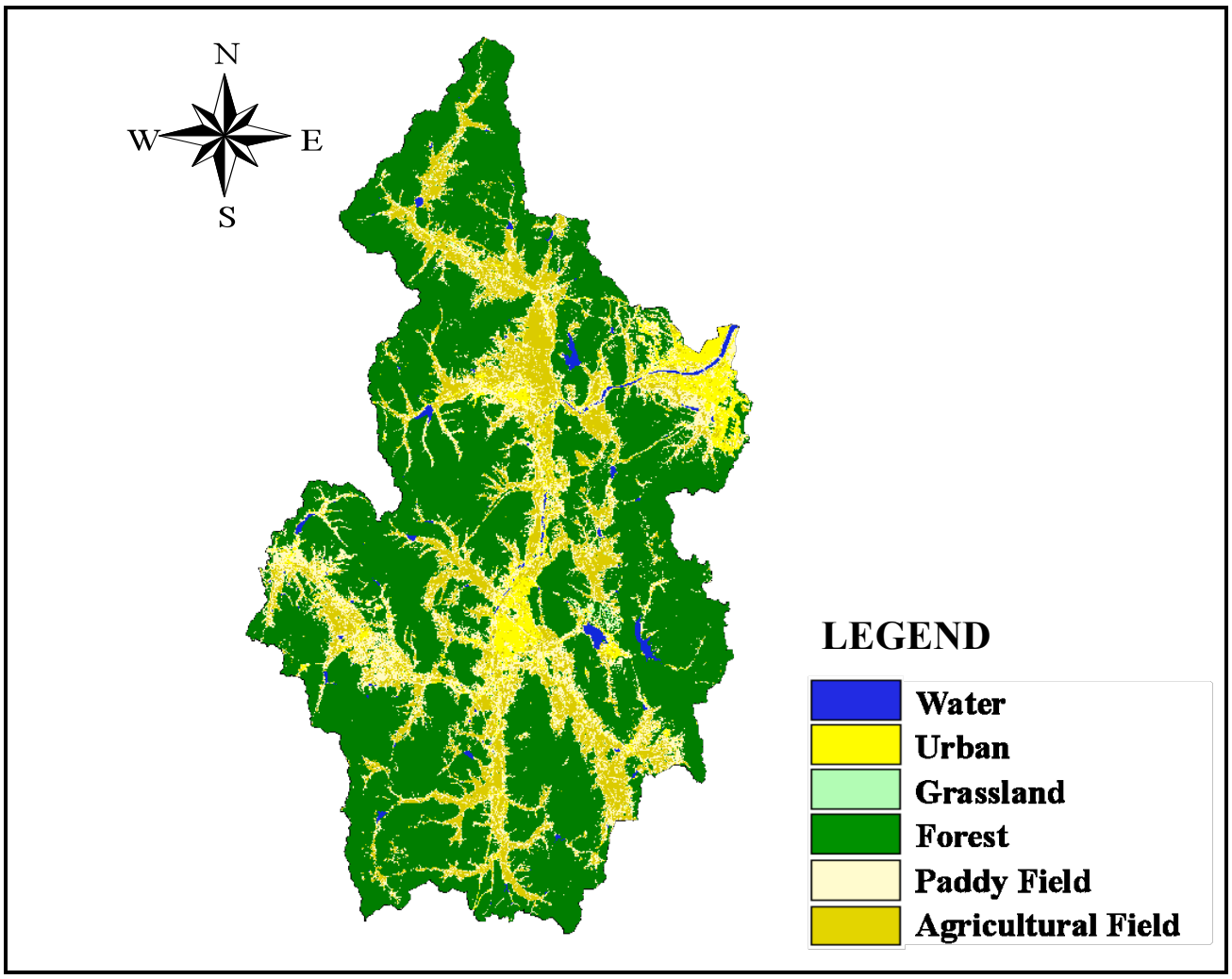
2.1 Geological Map



LEGEND

Bulguksa Granite
Yucheon Group
Hayang Group
Sedimentary Rocks

2.2 Land Use Map

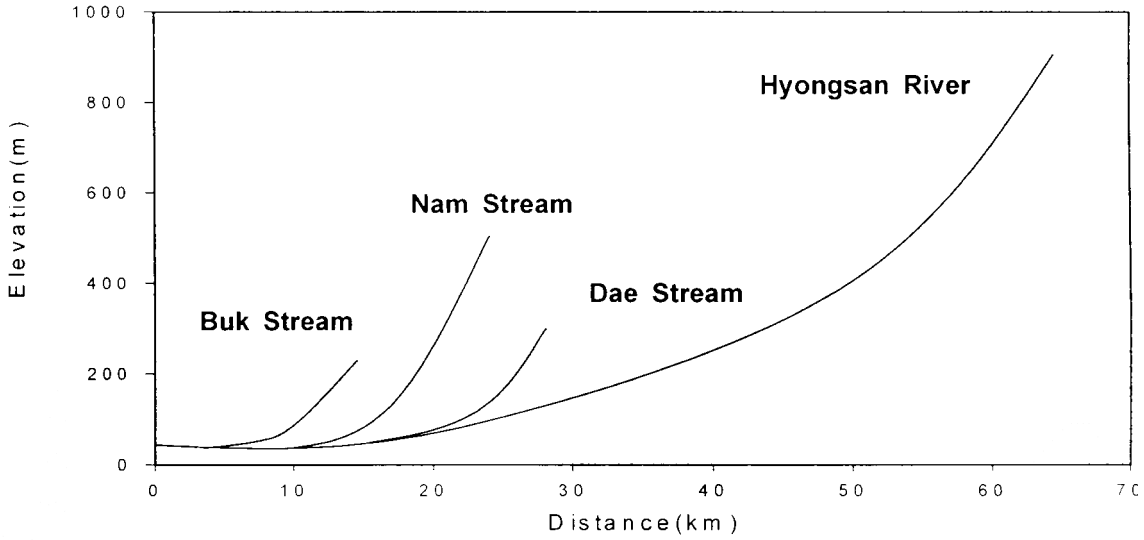


2.3 Characteristics of the River and the Main Tributaries

No.	Names of River	Length Catchment Area	Highest Peak	Cities Population (2007)	Land use (%)					
					F	W	P	A	U	G
1	Hyeongsan (Main Stream)	62.10km 1,166.80km^2	Mt. Baekwoon 901.0m	Gyeongju 276,877	69.1	5.4	12.3	6.0	6.2	1.0
2	Dae Stream (Tributary)	25.0km 160.0km^2	Mt. Daema 375.2m							
3	Nam Stream (Tributary)	23.0km 88.0km^2	Mt. Jibbong 542.5m							
4	Buk Stream (Tributary)	15.0km 79.1km^2	Mt. Hwangjang 342.6m							

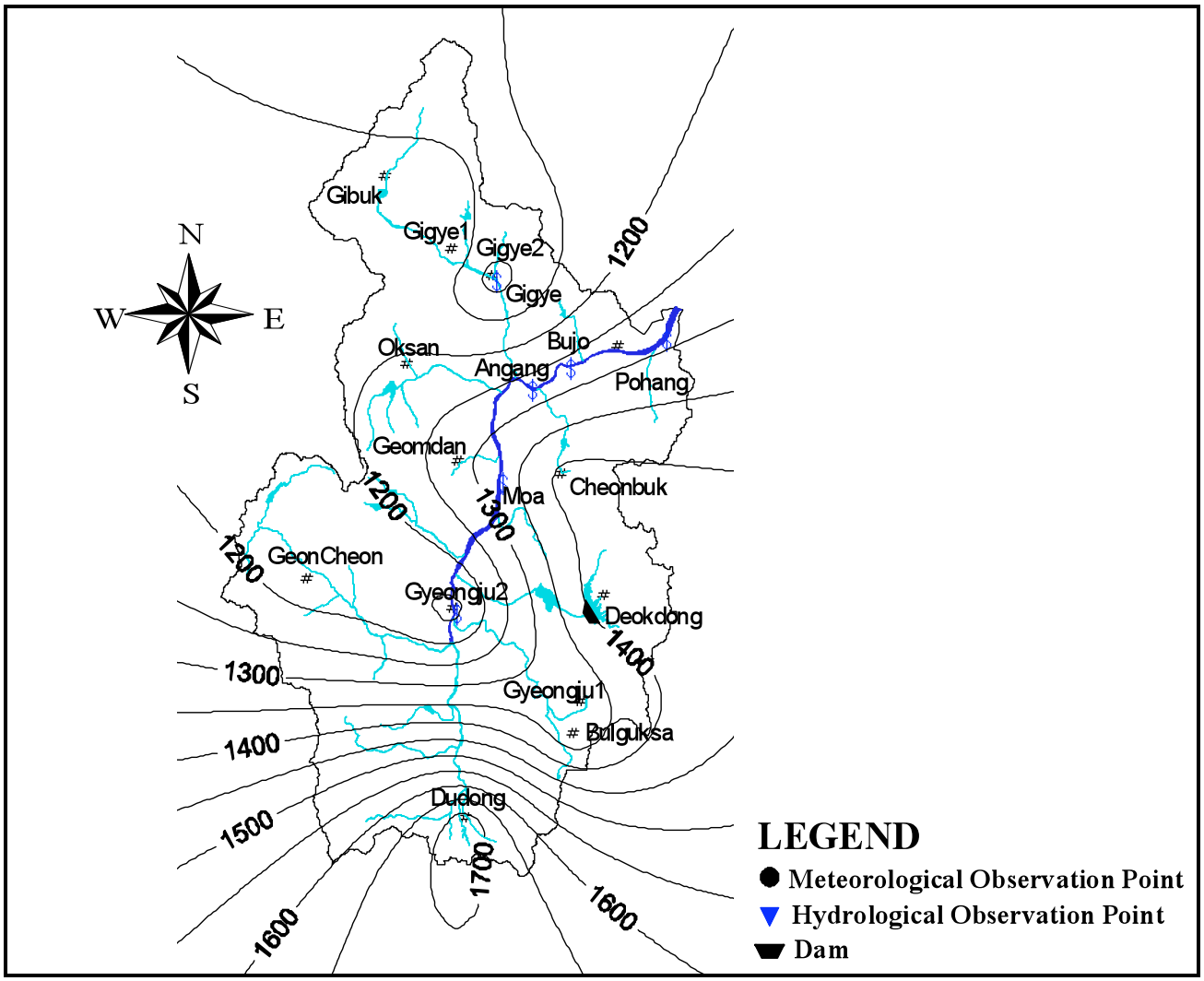
F : Forest W: Water P: Paddy Field A : Agricultural field U : Urban G : Grassland

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 (mm)	Mean annual Evaporation[1])	Observation Items
138*, **	Pohang	1	N 129° 23' 00″ E 36° 02' 00″	1949 ~ present	1,120	1253	P(TB),E,DS
21014010*	Gigye1	30	N 36° 04'18″ E129° 12' 37″	1998 ~ present	1,184	-	P(TB)
21014020*	Gyeongju1	20	N 35° 46' 30″ E129° 18' 02″	1998 ~ present	1,320	-	P(TB)
21014040*	Geoncheon	100	N 35° 51' 18″ E 129° 05' 13″	1998 ~ present	1,171	-	P(TB)
21014050*	Gibuk	120	N 36° 07' 00″ E 129° 09' 24″	1998 ~ present	1,155	-	P(TB)
21014060*	Oksan	60	N 35° 59' 33″ E 129° 10' 16″	1998 ~ present	1,209	-	P(TB)
21014070*	Gyeongju2	20	N 35° 50' 05″ E 129° 12' 12″	1998 ~ present	1,130	-	P(TB)
21014080*	Geomdan	80	N 35° 50' 05″ E 129° 12' 20″	1998 ~ present	1,292	-	P(TB)
21014090*	Dudong	90	N 35° 42' 05″ E 129° 12' 33″	1998 ~ present	1,732	-	P(TB)
21014100*	Gigye2	30	N 36° 03' 19″ E 129° 14' 38″	1998 ~ present	1,074	-	P(TB)
21014110*	Cheonbuk	80	N 35° 55' 11″ E 129° 17' 33″	1998 ~ present	1,418	-	P(TB)
21014120*	Bulguksa	70	N 35° 45' 01″ E 129° 17' 49″	1998 ~ present	1,315	-	P(TB)
21014130*	Dukdong	260	N 35° 50' 25″ E129° 19' 28″	1998 ~ present	1,439	-	P(TB)
21014140*	Pohang	20	N 36° 00' 06″ E129° 20' 21″	1998 ~ present	1,277	-	P(TB)

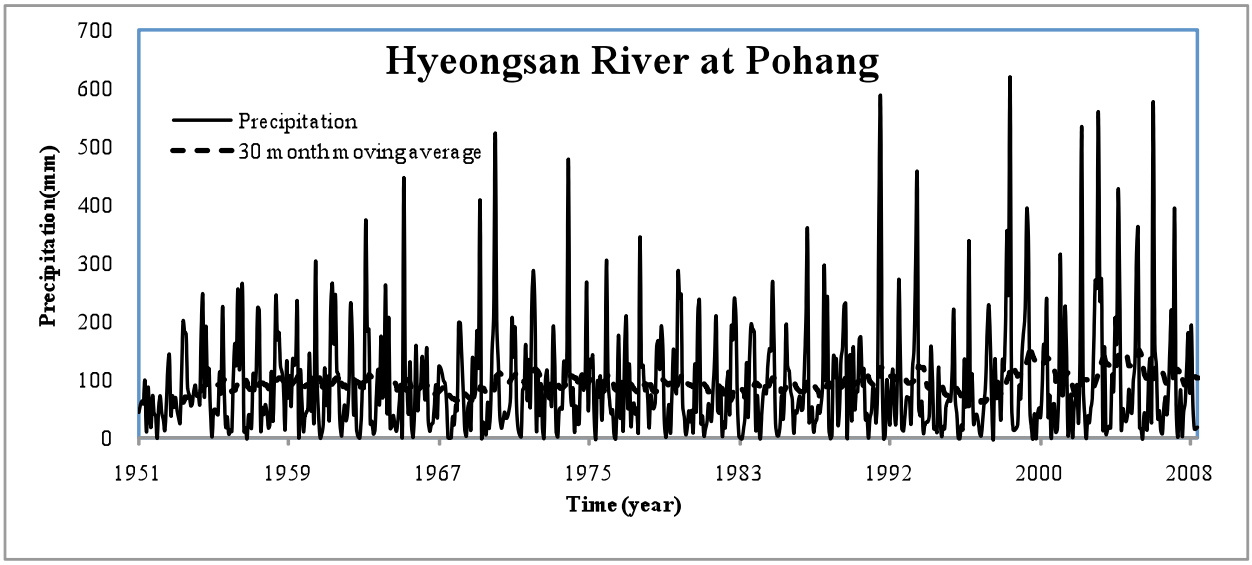
* : Serial number used by Ministry of Construction and transportation
** : Serial number used by Weather Office, Korea Meteorological Agency
P: Precipitation, E: Evaporation, DS: Duration of sunshine, TB: Tipping bucket with recording chart
1) Measured by 20cm pan

3.3 Monthly Climate Data (Observation station : Pohang)

Observation item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	1.6	3.1	7.4	13.4	17.9	21.0	24.8	25.4	21.3	16.1	9.9	4.0	13.8	1949 ~ present
Precipitation[mm]	41	43	67	79	75	139	182	208	160	52	48	26	1,120	1949 ~ present
Evaporation[mm]*	64	64	91	128	160	135	139	137	101	96	72	66	1253	1949 ~ present
Solar radiation [MJ/ m^2/day]	8.6	11.1	13.4	16.5	17.6	16.7	14.9	14.5	12.2	11.4	8.9	8.1	12.8	1949 ~ present
Duration of sunshine[hr]	182	168	186	208	226	166	159	167	158	188	173	186	2,167	1949 ~ present

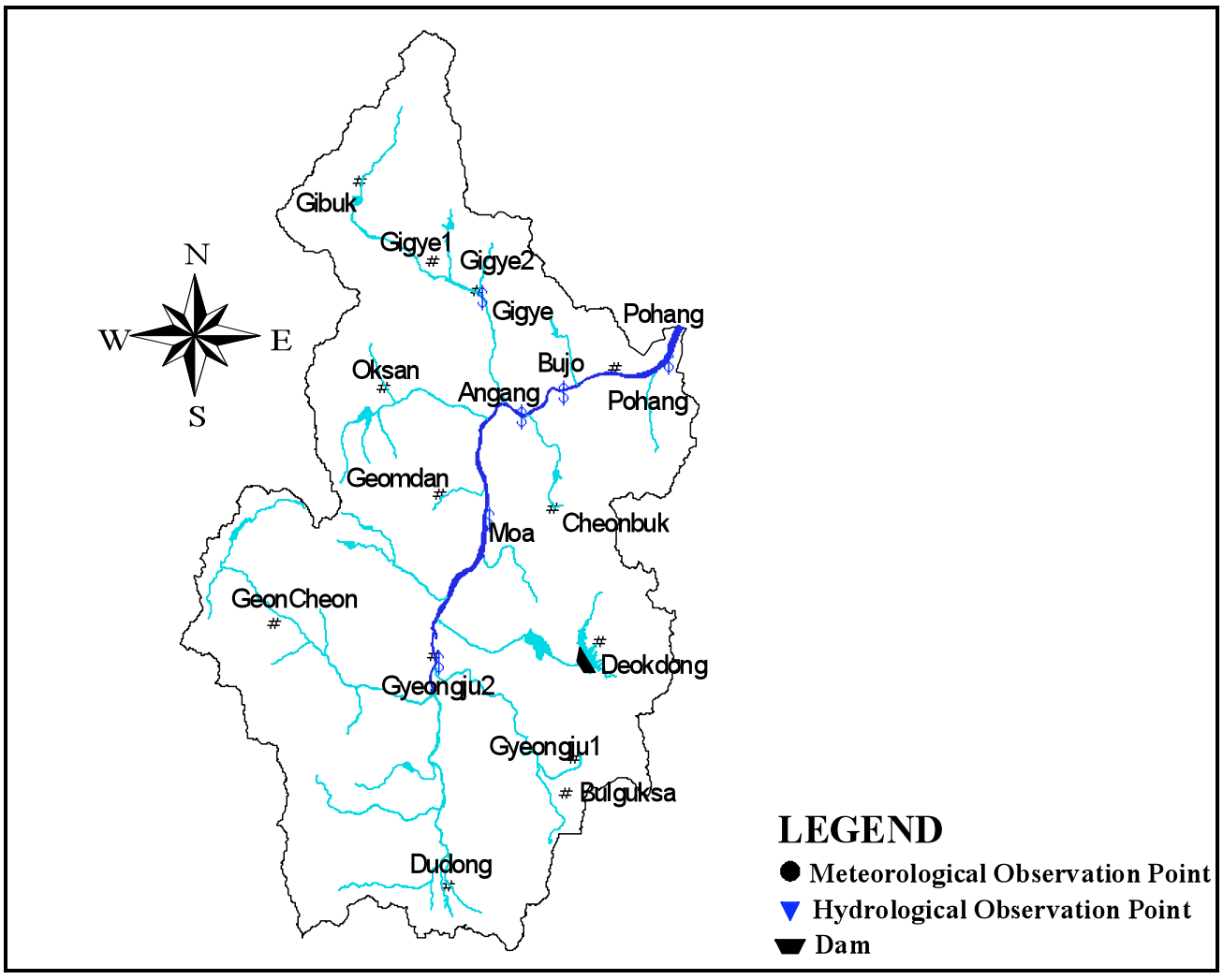
*measured by 20cm pan

3.4 Long-term Variation of Monthly Precipitation Series



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



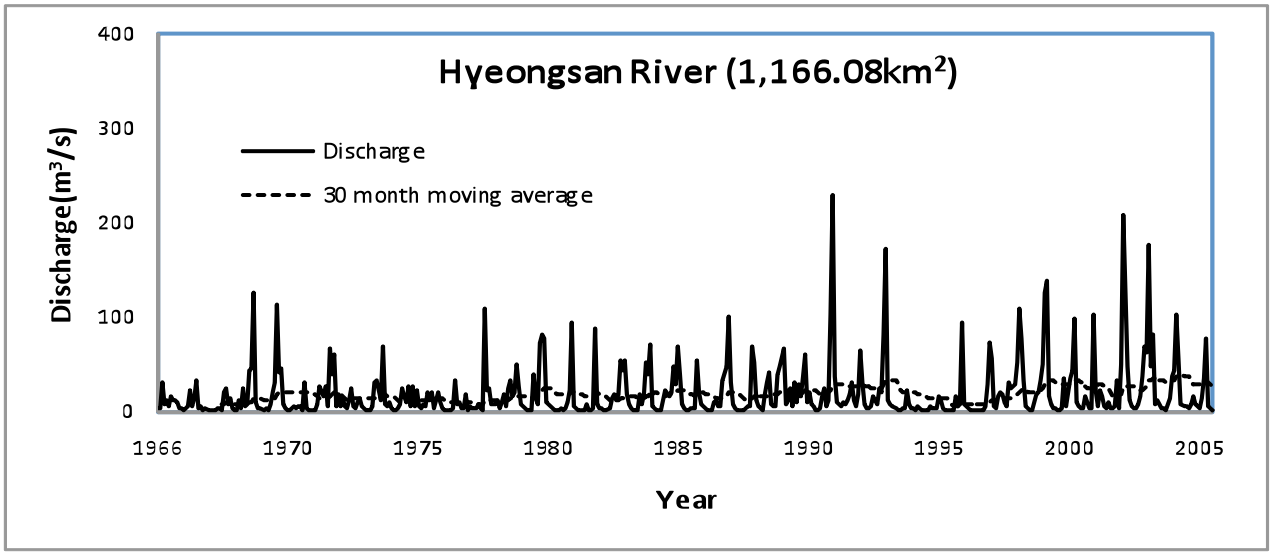
4.2 List of Hydrological Observation Stations

No.	Station	Location	Elevation [m]	Catchment area (A) [km²]	Observation period	Observation items[1] [Frequency]
2101690	**Pohang**	N 36° 40′ 30″ E 129° 22′ 30	-0.93	1,086	1952 ~ present	H1
2101680	**Bujo**	N 35° 59′ 35″ E 129° 18′ 15	-0.94	925	1952 ~ present	H1
2101675	**Angang**	N 35° 58′ 41″ E 129° 16′ 04	0.77	908	1962 ~ present	H1
2101668	**Gigye2**	N 36° 03′ 06″ E 129° 14′ 27	21.56	185	1998 ~ present	H1
2101650	**Moa**	N 35° 55′ 10″ E 129° 14′ 35	9.11	672	1962 ~ present	H1
2101625	**Gyeongju2**	N 35° 50′ 17″ E 129° 12′ 05	26.71		1998 ~ present	H1

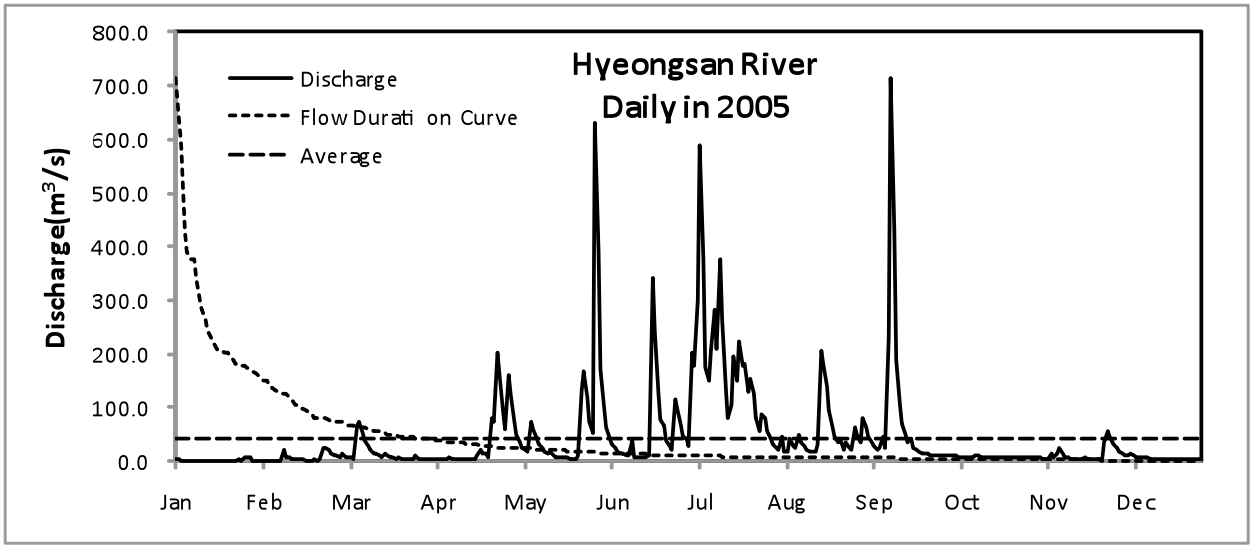
No. *	$\overline{Q}$ [2] [m³/s]	Q max[3] [m³/s]	$\overline{Q}$ max [4] [m³/s]	$\overline{Q}$ min [5] [m³/s]	$\overline{Q}$ / A [m³/s/100km²]	Qmax / A [m³/s/100km²]	Period of statistics
210690	18.3	3,126.1	44.1	4.0	1.68	4.06	1966 ~ present

*: Serial number used by Ministry of Construction
1) H1 : water level in recording chart H2 : water level by manual
Q : discharge, P: precipitation, WQ : BOD etc., S : sedimentation
d : daily, 10d:10-daily, m: monthly
2) Mean annual discharge
3) Maximum discharge
4) Mean annual maximum discharge
5) Mean annual minimum discharge

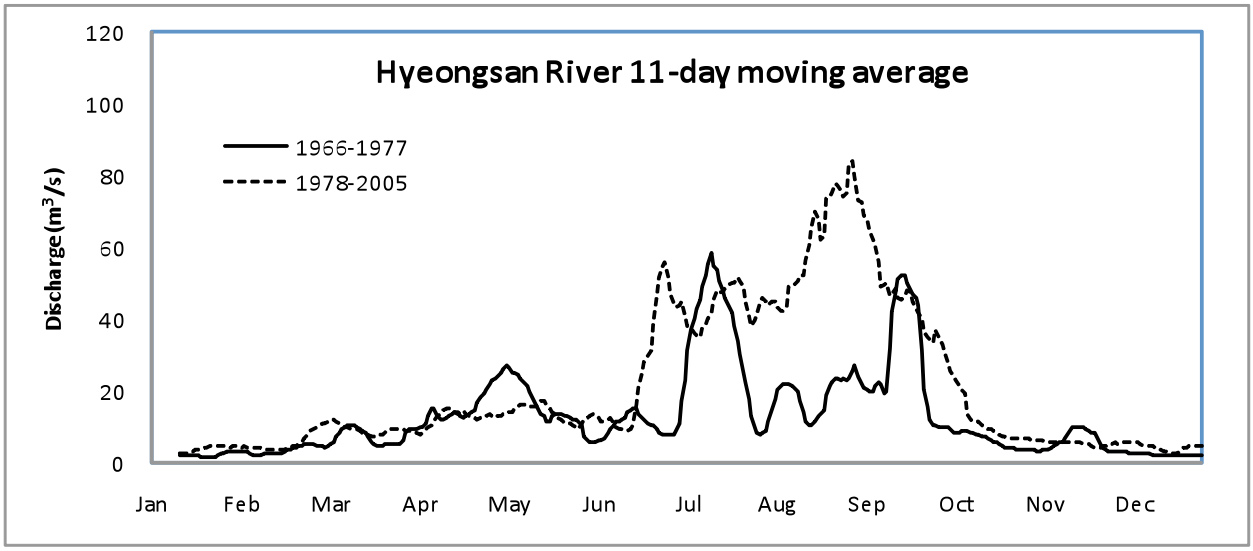
4.3 Long-term Variation of Monthly Discharge Series



4.4 Annual Pattern of Discharge Series



4.5 Unique Hydrological Features



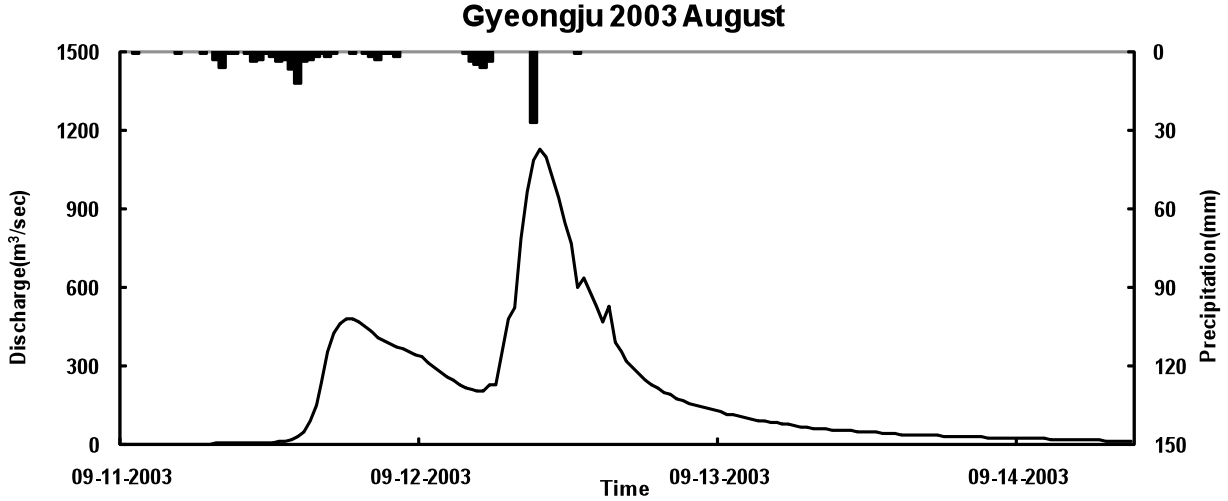
*** Note that Deokdong Dam constructed in 1977.**

4.6 Annual Maximum and Minimum Discharges

At Pohang

Year	Maximum		Minimum		Year	Maximum		Minimum	
	Date	(m^3/s)	Month	(m^3/s)		Date	(m^3/s)	Month	(m^3/s)
1966	3.7	198.8	2	1.5	1986	6.25	572.4	12	0.6
1967	7.6	210.5	11	0.7	1987	8.31	831.0	1	0.8
1968	8.17	211.8	3	0.2	1988	8.16	510.0	3	0.3
1969	9.15	1,080.6	2	0.8	1989	8.23	366.8	1	0.8
1970	7.17	462.5	2	0.5	1990	7.16	427.2	12	1.4
1971	8.5	149.8	12	0.4	1991	8.23	3,126.1	2	0.6
1972	9.14	659.6	1	0.2	1992	8.18	339.6	12	1.5
1973	9.10	130.3	12	1.0	1993	8.10	983.6	1	1.4
1974	7.6	640.2	2	0.5	1994	5.25	177.4	10	0.5
1975	9.17	189.2	1	1.1	1995	8.31	228.3	4	0.1
1976	6.8	196.9	12	0.8	1996	6.25	775.7	3	0.1
1977	9.9	147.5	2	0.3	1997	8.10	628.5	4	0.0
1978	6.18	962.3	6	0.9	1998	9.30	1,864.4	12	2.2
1979	8.26	526.9	1	1.7	1999	9.23	753.0	3	0.5
1980	9.11	893.0	3	0.3	2000	9.15	886.8	4	0.3
1981	9.3	971.6	6	0.7	2001	6.24	958.3	2	0.7
1982	8.14	603.2	2	0.3	2002	8.31	1,491.0	4	1.3
1983	8.28	332.2	1	0.7	2003	9.12	714.3	2	1.6
1984	9.3	882.6	4	0.3	2004	8.19	1,001.6	4	0.8
1985	9.19	658.4	2	0.4	2005	9.6	1,135.5	12	1.4

4.7 Hyetographs and Hydrographs of Major Floods



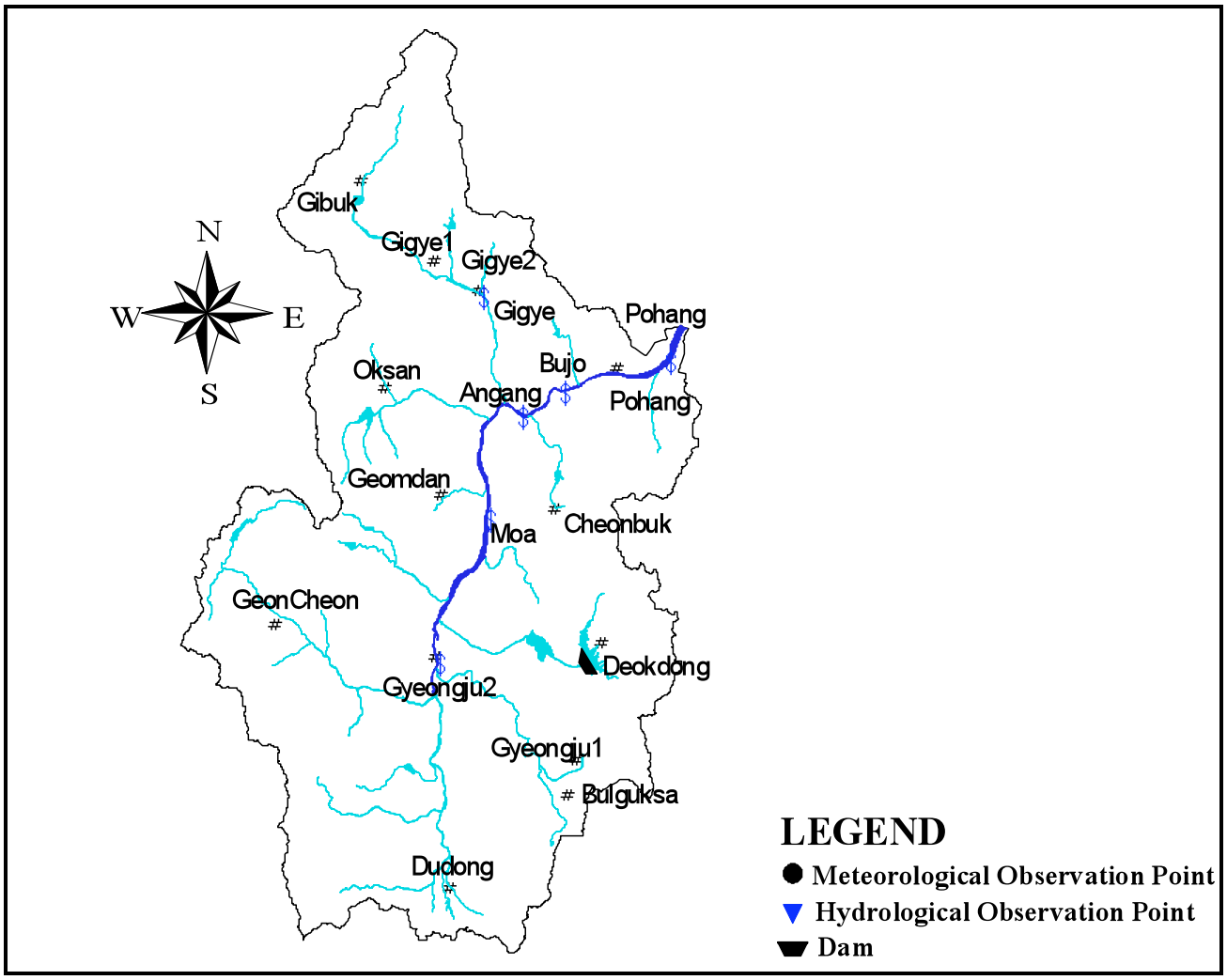
Based on the data of Ministry of Construction and Transportation

5 Water Resources

5.1 General Description

The Hyeongsan River Stream, which occupies 1,160.80km^2 watershed basin, consist of the upper stream that is mountainous area and the lower stream that is a plane area. The agricultural and forest area in the basin occupy about 20% and 65% of total area in the watershed basin respectively. The runoff in the river in the dry season is very little even though the flood in the rainy season is often indicated. To meet the agricultural water demand, which is called as Deokdong Dam, was constructed. Nowadays, almost all agricultural water in the basin is supplied from the Bomoonho reservoir.

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 [10^6m^3]	Effective capacit [(10^6m^3]	Purpose[1)]	Year of completion
Hyeongsan (main)	Deokdong	51.70	327	318	W, A	1977

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				
Buk Stream Line	Deokdong Dam	Gyeongju	20.5	347.2	W, A	1977

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

5.4 Major Flood and Drought Experiences

Major Floods (Catchment area 1,166.80km^2)

Date	Peak discharge [m^3/s]	Rainfall [mm] Duration	Meteorological cause	Dead and missing	Major damages [Districts affected]
1987. 9. 11	1,836.8	208.5 9. 11 ~ 9. 20	Storm	--	Pohang, Gyeongju
1991. 8. 24	2,445.9	394.4 8. 22 ~ 8. 24	Storm	--	Pohang, Gyeongju
1998. 9.28	3,998.1	611.3 9. 28 ~ 10. 1	Storm	--	Pohang, Gyeongju
2002.8.31	3,138.0	134 8.31 ~ 9.1	Storm	--	Pohang, Gyeongju

Major Droughts

Period	Areas Affected	Major damages and counteractions
1976 ~ 1977	Pohang, Gyeongju	Supply cut : ratio at the first stage: 24%
1981 ~ 1982	Pohang, Gyeongju	Supply cut : ratio at the first stage: 15%
1994 ~ 1995	Pohang, Gyeongju	Damage : crops of 13%
2000 ~ 2001	Pohang, Gyeongju	Damage : crops of 7%

5.5 Groundwater and Water Quality

River Water Quality[1)] at Hyeongsan River[2)], 2005

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PH	7.5	7.7	7.7	7.6	8.4	8.4	8.3	8.2	7.4	7.6	7.7	7.6
BOD [mg/I]	2.1	2.2	2.9	2.1	4.6	3.6	4.9	6.6	1.9	1.8	2.4	1.7
COD_{Mn} [mg/I]	4.5	5.1	5.8	4.4	8.0	7.3	8.8	9.4	4.5	4.0	5.2	4.6
SS [mg/I]	1.6	3.5	6.3	4.3	8.9	4.8	12.0	14.4	5.9	4.3	5.1	3.1
Coliform group [MPN/100ml][3)]	2,700	1,650	5,650	500	500	2,900	2,300	440	1,000	660	560	230
Discharge[m^3/s][4)]	3.8	7.2	16.4	7.4	4.3	4.2	14.6	34.3	77.5	4.6	3.1	1.7

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

6. Socio-cultural Characteristics

The Hyeongsan river is flowing through the sourth-eastern part of Gyeongbuk province, Korea peninsular. There are urban cities such as Gyeongju and Pohang where are very beautiful mountainous area of clean water, fresh air and many ancient temples. Especially, about a thousand years ago, Kyongju was the capital city of the Shilla kingdom having its glorious culture at its height. These are the most natural regions of Gyeongbuk province and famous of hot-spring and mineral water which tastes very unique.

7. References, Databooks and Bibliography

Korean Meteorological Administration, Annual Climatological Report, 1966-200, (in Korean)
Ministry of Land, Transport and Maritime Affairs, Flood in Korea, 1973-2008, (in Korean).
Ministry of Environment, Annual Report of Water Quality Observation, 2005, (in Korean)
Nakdong River Flood Control Office (http://www.nakdongriver.go.kr)
WAMIS, K-WATER (http://www.wamis.go.kr)
Korea National Statistical Office (http://www.nso.go.kr)