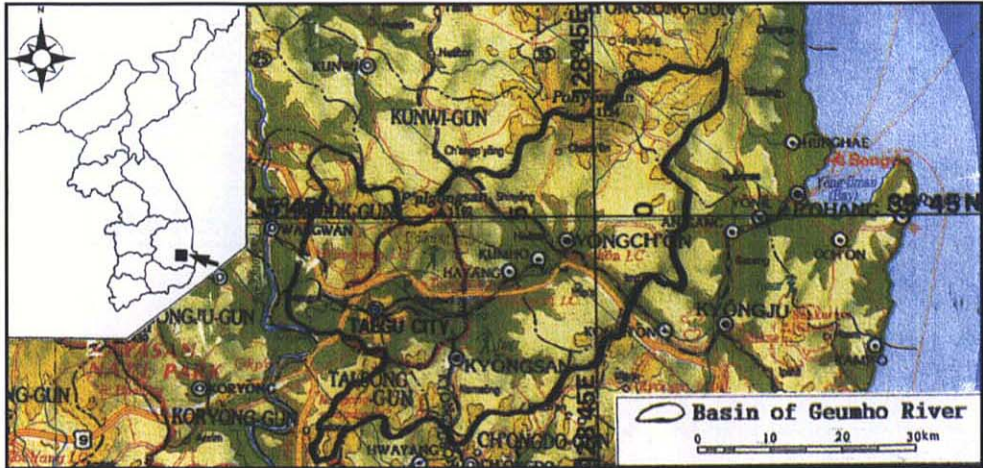


Geumho-gang

Map of River

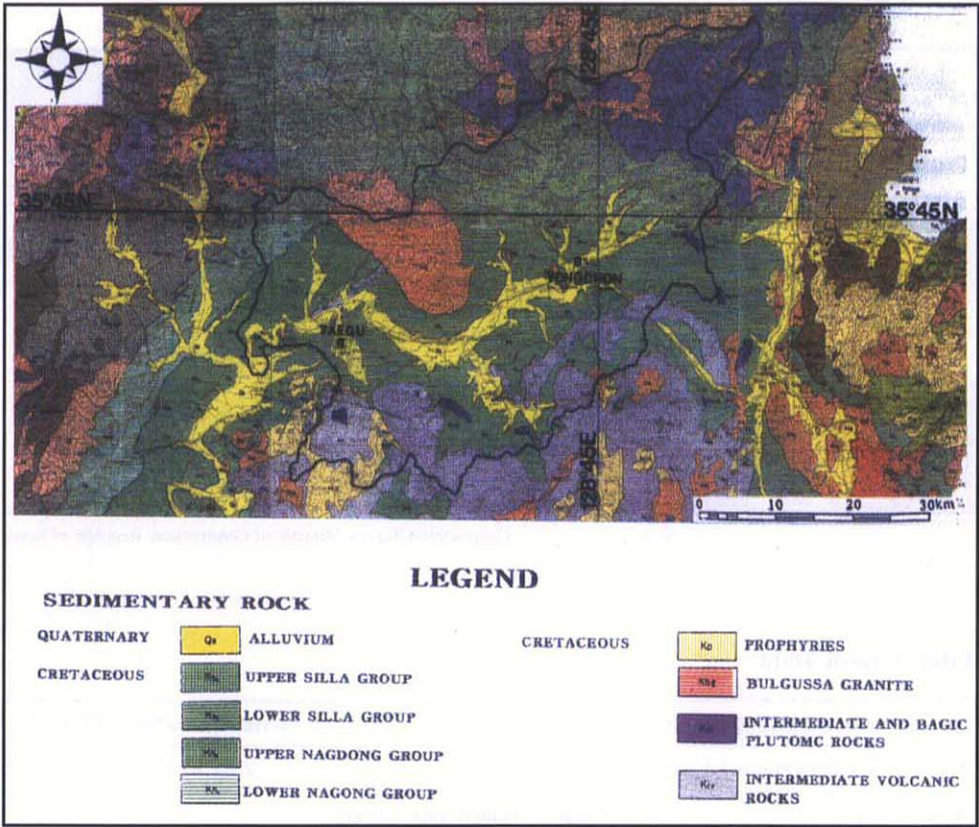


Geographical Survey, Ministry of Construction, Republic of Korea

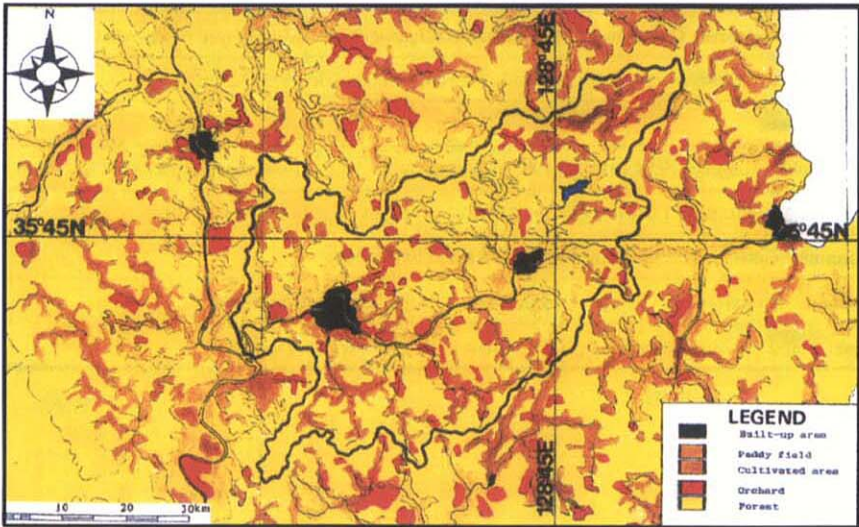
Table of Basic Data

Name: Geumho River (Left branch of Nakdong River)		Serial No.: Republic of Korea-2
Location: Kyongbuk Province, Korea	N 35° 42' ~ 36° 15'	E 128° 25' ~ 129° 12'
Area: 2 088 km ²	Length of main stream: 118 km	
Origin: Mt. Gato (720 m)	Highest point: Mt. Palgong (1 192 m)	
Outlet: Nakdong River	Lowest point: Confluence with Nakdong River (24.8 m)	
Main geological features: Cretaceous to Middle Mesozoic; Igneous rocks, Alluvial layer Weathered stone		
Main tributaries: Shin River (159.3 km ²), Oro River (173 km ²), Shinrung River (342.2 km ²)		
Main lakes: None		
Main reservoirs: Yongchon (96.4 x 10 ⁶ m ³ , 1980), Kyongsan (4.5 x 10 ⁶ m ³ , 1981), Gachang (9.1 x 10 ⁶ m ³ , 1986)		
Mean annual precipitation: 1 031 mm (1960~1992)(basin average)		
Mean annual runoff: 15.3 m ³ /s at Dongchon (1 528.9 km ³) (1960~1992)		
Population: 2 650 000 (1992)	Main cities: Taegu, Kyongsan, Yongchon	
Land use: Forest (76.24%), Rice paddy (7.09%), Urban (3.14%), Other (12.32%) (1992)		

2. Geographical Information
2.1 Geological Map



2.2 Land Use Map



1. General Description

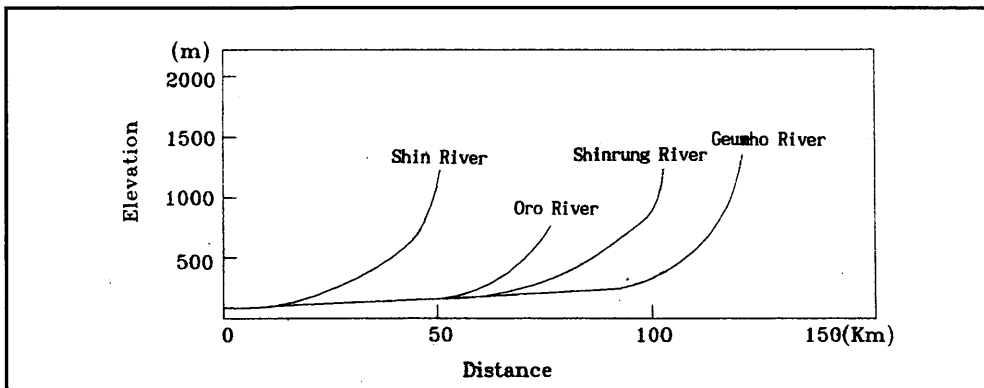
The Geumho River, one of the main tributaries of the Nakdong River, is 118.4 km long and has a catchment area of 2 088 km². It originates from Mt. Gato (720 m), flows through the south-eastern part of the Korean Peninsula and joins the middle part of the main stream of Nakdong River. The average annual precipitation in the basin during the period 1960~1992 has been 1 031 mm and the average annual discharge at Dongchon (1 529 km²) during the same period has been 15.3 m³/s (1.59 m³/s/km²). The basin population was 2 650 000 in 1992. One of the main hydraulic structures in the basin, the Yongchon Dam was built in 1980 to store 96.4 x 10⁶ m³. The river segment above Yongchon is considered the upper stream, which is in the mountains with narrow and hillside paddy fields. Between Yongchon and Dongchon is the middle stream and below Dongchon is the lower stream. The middle and lower streams flow from east to west through the narrow plain between the high mountain areas in the north and south.

2.3 Characteristics of River and Main Tributaries

No.	Name of river	Length [km] Catchment area [km ²]	Highest peak [m] Lowest point [m]	Cities Population (1990)	Land use [%] (1991)
1	Geumho (Main River)	118.4 1 412.4	Mt. Palgong, 1 192.3 -----	Taegu City 2 227 000	A (12.3) F (67.3)
2	Shin (Tributary)	28.2 159.3	Mt. Biseul, 1 084 -----	Taegu City 360 000	L (0.4) O (9.8)
3	Oro (Tributary)	33.0 173.0	Mt. Gureong, 675 -----	Kyongsan City 18 000	P (7.1) U (3.1)
4	Shinrung (Tributary)	35.4 343.2	Mt. Bangga, 755.8 -----	Yongchon City 45 000	

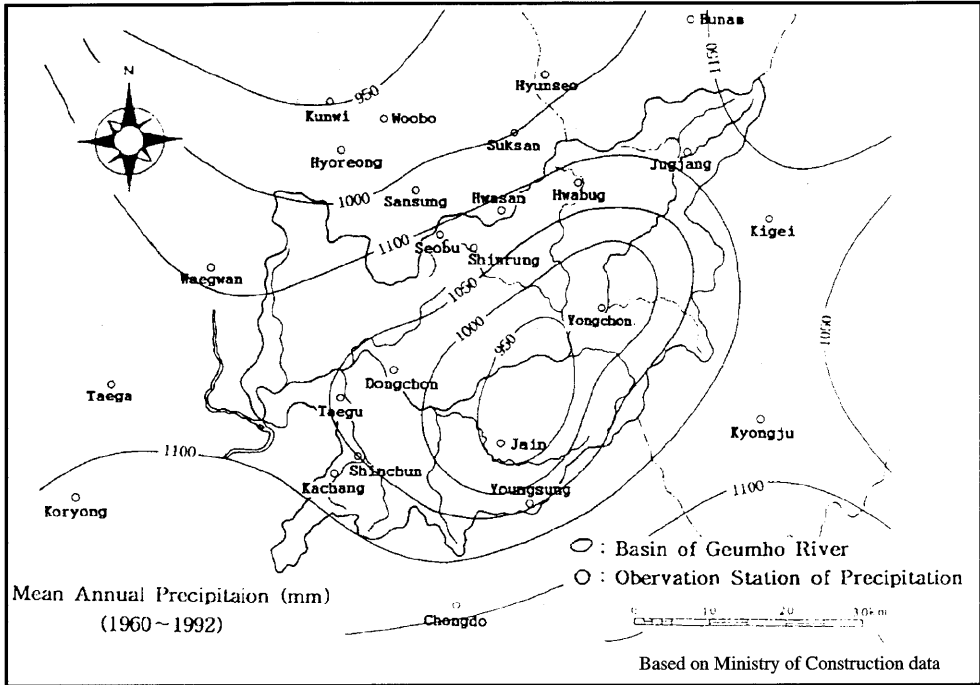
A: Other agricultural field F: Forest L: Lake, River, Marsh O: Orchard P: Paddy field U: Urban

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyetal Map and Precipitation Observation Stations



3.2 List of Meteorological Observation Stations

No.	Station	Elevation [m]	Location	Observation period	Mean annual precipitation ¹⁾ [mm]	Mean annual evaporation ²⁾ [mm]	Observation items ³⁾
111**	Taegu	57.8	N 35° 53' 06" E 128° 38' 37"	1961~present	1 030.6	1 331.8	P(TB)
131**	Yongchon	91.3	N 35° 57' 48" E 128° 55' 28"	1961~ present	982.1	1 084.8	P(TB)
142*	Shinrung	30.0	N 36° 02' 41" E 128° 47' 30"	1963~ present	1 109.7		P
148*	Jain	70.0	N 35° 49' 02" E 128° 49' 22"	1965~ present	941.5		P
150*	Jukjang	214.0	N 36° 09' 25" E 129° 05' 50"	1962~ present	1 157.8		P

*: Serial number used by Ministry of Construction

** : Serial number used by Weather Office, Korea Meteorological Agency

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

2) Measured by 20 cm pan

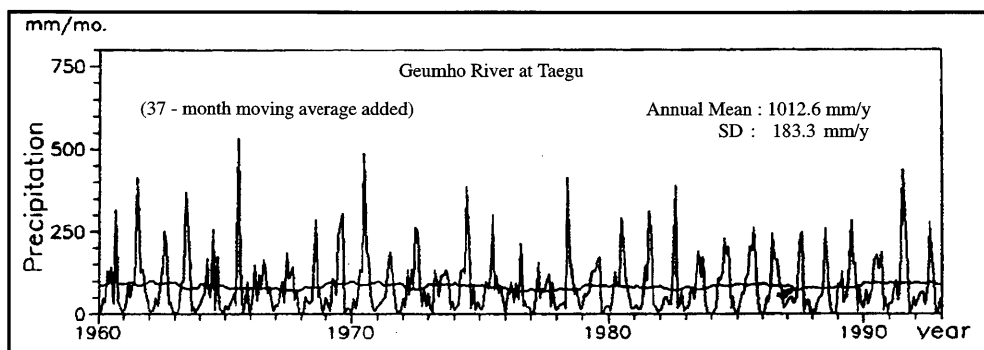
3) P: Precipitation, TB: Tipping bucket with recording chart.

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]	Taegu	-0.7	1.3	6.5	13.2	18.5	22.2	25.7	26.3	21.0	15.0	8.1	1.8	13.2	1961~1990
Precipitation [mm]	Taegu	20.5	28.8	50.7	78.0	75.2	128.6	233.5	193.0	122.8	48.1	37.3	14.1	1 030.6	1961~1990
Evaporation [mm]*	Taegu	56.7	63.0	103.1	134.9	173.0	162.7	150.0	160.7	113.4	95.8	64.4	54.1	1 331.8	1961~1990
Solar radiation [MJ/m ² /d]	Taegu	8.87	10.44	13.30	16.34	17.91	16.58	14.24	14.86	12.62	11.50	8.63	7.84	12.76	1961~1990
Duration of sunshine [hr]	Taegu	196	180	215	213	240	297	164	189	170	206	178	190	2 337	1961~1990

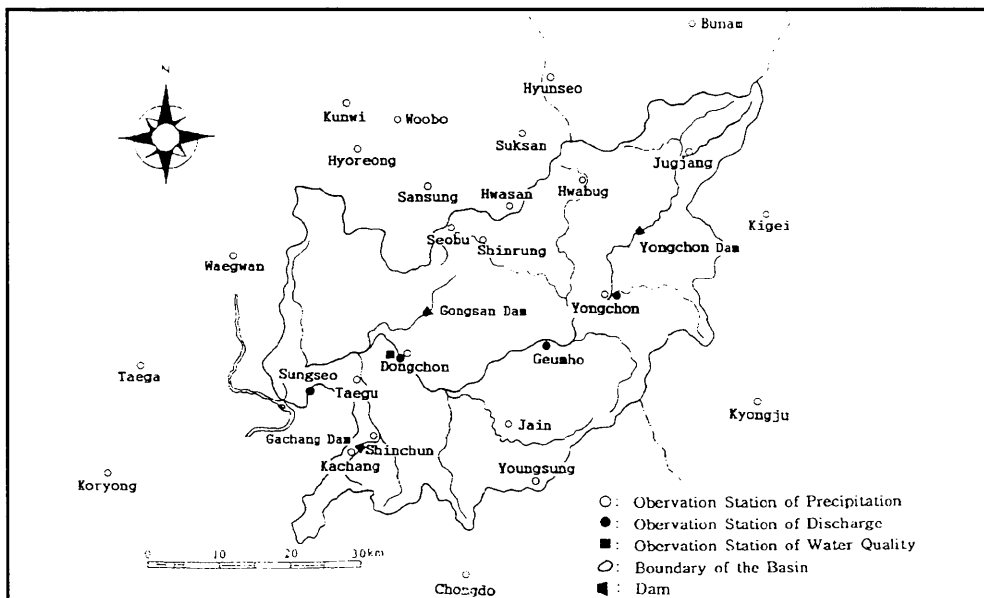
* measured by 20 cm pan

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 ²]	Observation period	Observation items ¹⁾
620*	Sungseo	N 35° 51' E 128° 38'	2 088	1962~present	H1
597*	Dongchon	N 35° 52' E 128° 36'	1 529	1923~ present	H1
621*	Geumho	N 35° 58' E 128° 30'	1 123	1933~ present	H1
612*	Danpo	N 35° 58' E 128° 25'	441	1973~ present	H1

No.*	\bar{Q} ²⁾ [m ³ /s]	Q max 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]	Q max / A [m ³ /s/100km ²]	Period of statistics
620*	22.4	3 296	1 573	7.81	1.07	157.85	1960~1992
597*	15.3	2 434	1 165	4.55	1.00	159.19	1960~1992
621*	11.5	1 825	897	3.34	1.02	162.46	1960~1992
612*	4.4	702	339	1.31	0.99	159.19	1973~1992

*: Serial number used by Ministry of Construction

1) H1: Water level in recording chart

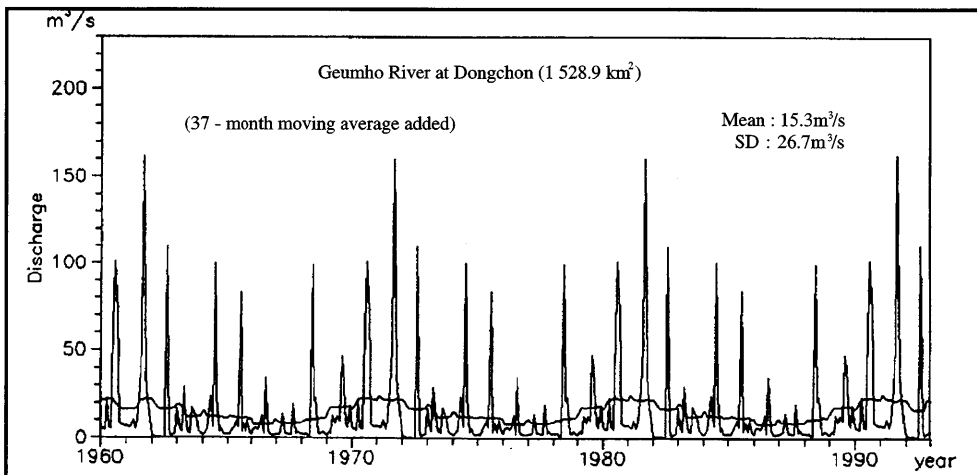
2) Mean annual discharge

3) Maximum discharge

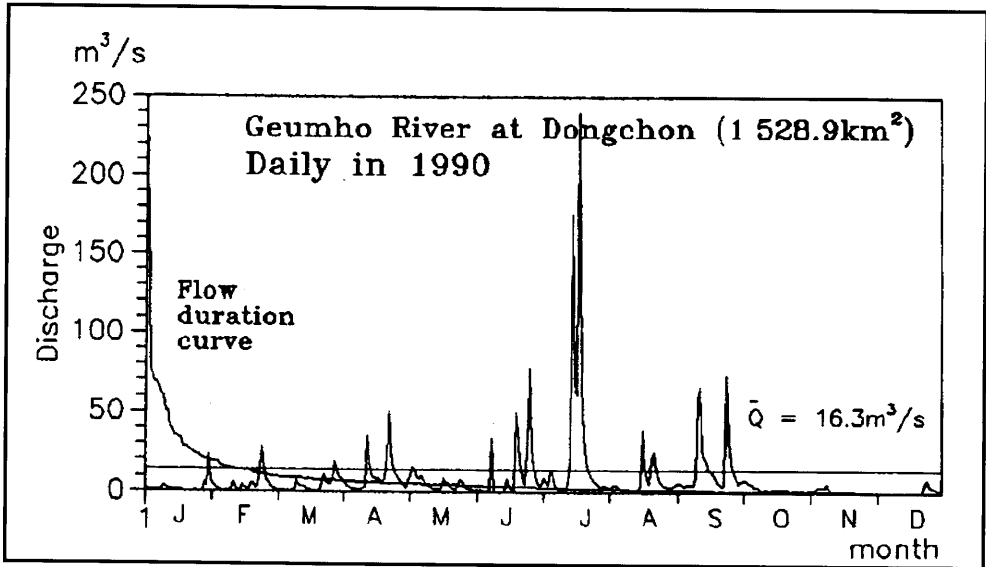
4) Mean annual maximum discharge

5) Mean annual minimum discharge

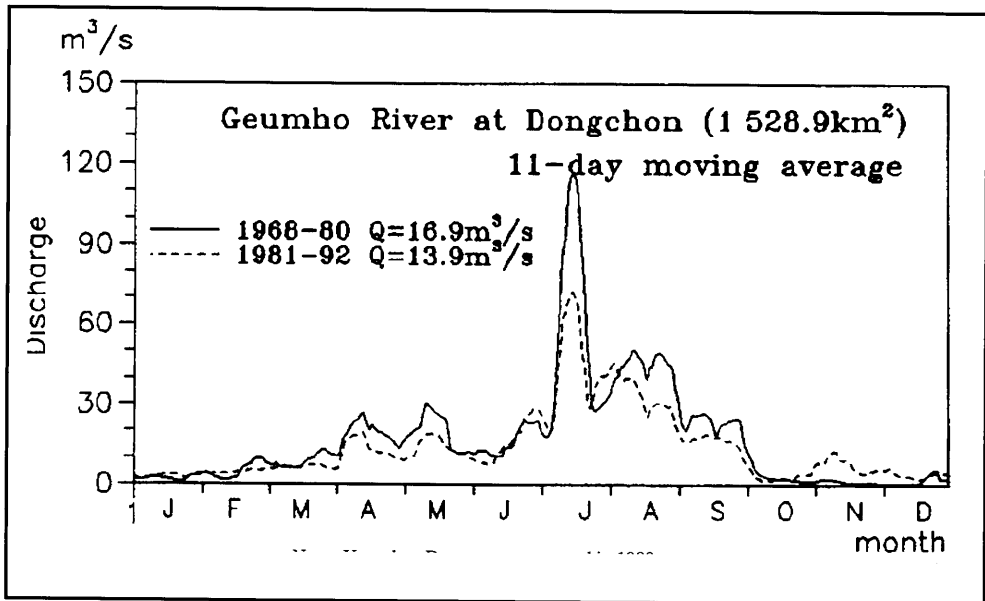
4.3 Long-term Variation of Monthly Discharge



4.4 Annual Pattern of Discharge



4.5 Unique Hydrological Features



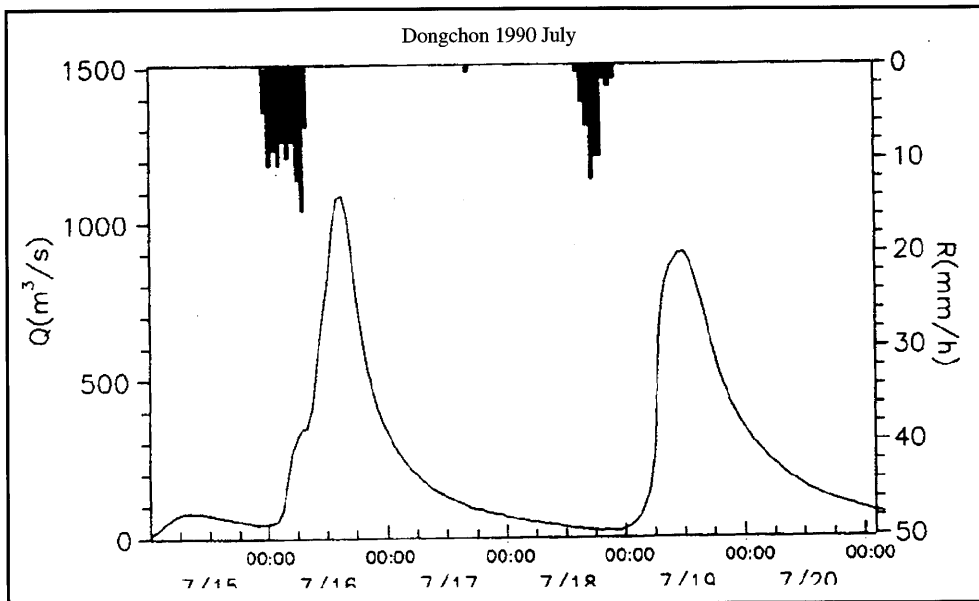
4.6 Annual Maximum and Minimum Discharges

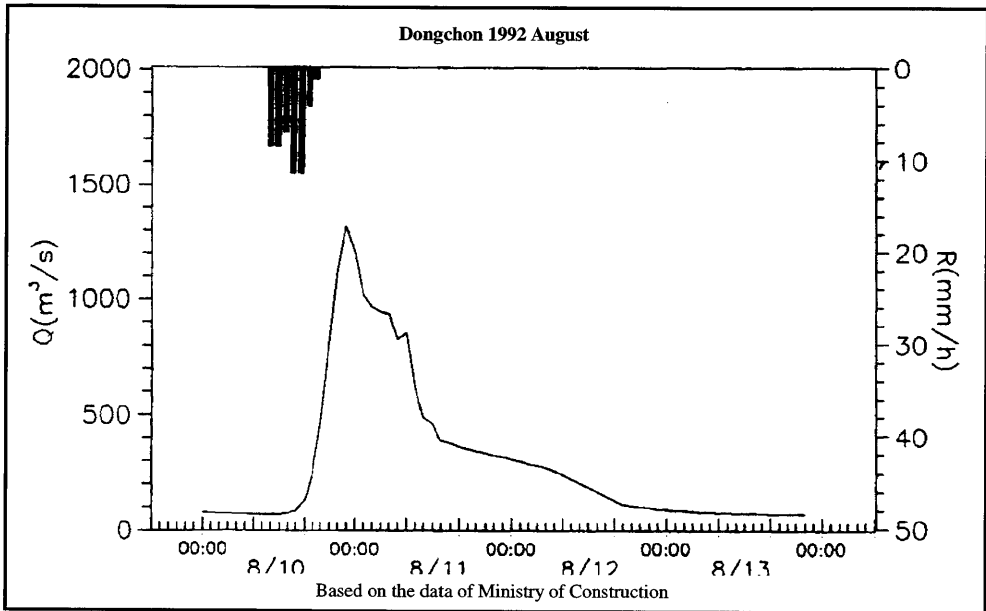
At Dongchon [1 529 km²]

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]
1970	7.17	1 982.8	12	8.9	1982	8.14	2 433.9	7	0.6
1971	7.01	747.1	12	10.6	1983	7.23	785.7	6	1.4
1972	8.20	1 075.7	12	9.9	1984	9.03	1 734.7	10	4.7
1973	4.24	537.0	7	8.7	1985	9.19	1 438.5	12	4.7
1974	7.12	730.8	8	4.9	1987	7.20	953.3	12	2.9
1976	6.08	472.3	8	2.0	1988	9.05	1 809.8	12	4.2
1977	9.09	452.7	8	2.9	1989	6.30	789.2	1	3.7
1978	6.20	1 519.2	6	1.7	1990	8.27	1 091.4	6	3.1
1980	9.12	933.2	5	4.4	1992	8.29	1 323.8	1	1.5
1981	8.30	1 294.4	8	1.5					

1), 2) : Instantaneous observation by recording chart.

4.7 Hyetographs and Hydrographs of Major Floods





5. Water Resources

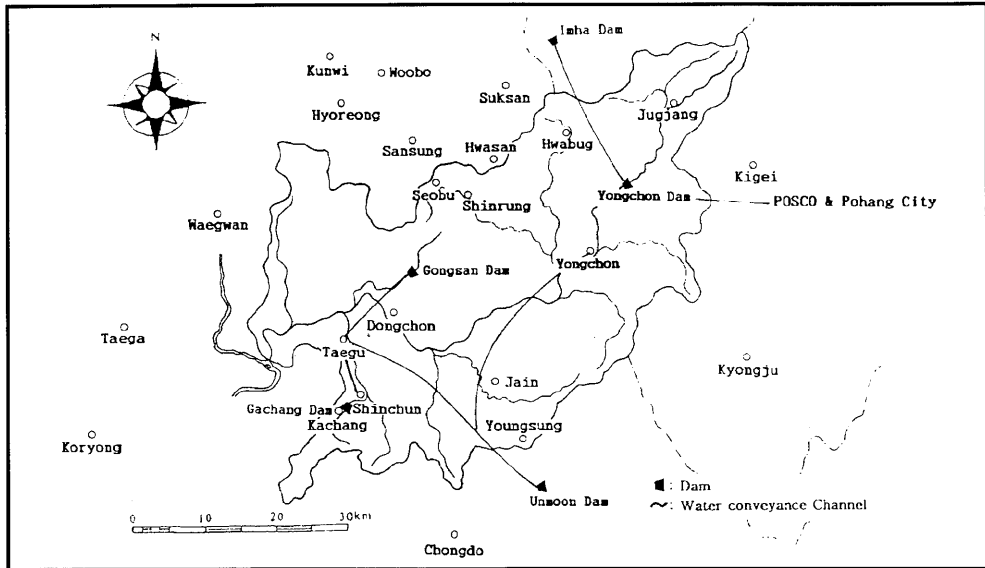
5.1 General Description

The Geumho occupies about 10% of the Nakdong River basin. Because it provides water supply within its own basin as well as to neighbouring basins, the quantity and quality of water in Geumho is of critical concern. Therefore many diversion tunnels and canals have been built to and from the Geumho. Such interbasin water transfers include Geumho to the eastern Hyungsan River basin, northern Imha Dam of Banbyun River basin to Geumho, western Nakdong main stream to Geumho and the southern Unmoon Dam of Milyang River basin to Geumho. However, the basin has been experiencing severe water shortages and deterioration of water quality in the Geumho main stream. These are attributed to the increase of water demand in municipal and industrial sectors and heavy industrial activities in the basin which have been growing more rapidly compared with the development of water supply and sewage treatment facilities.

The average annual precipitation in the basin is far less than the average for the country. Because the rainfall is mostly concentrated in the summer between June and September, the basin is prone to flooding and droughts every year.

During the 23 year period from 1970~1992, major floods with discharges in excess of 100 m³/s, or 0.654 m³/s/km² at Dongchon (1 528.9 km²) occurred 12 times, or approximately once every two years. The maximum flood flow of this station has been 2 434 m³/s in 1982 while the minimum flow has been 0.6 m³/s in the same year. After the completion of the Yongchon Dam (96.4 x 10⁶ m³) in 1980 and the subsequent water transfer of 0.22 x 10⁶ m³/day to the Pohang steel mill in the eastern region, it is noticeable that the minimum flows at Dongchon have been decreasing.

5.2 Map of Water Resource Systems



5.3 List of Major Water Resources Facilities

Major Reservoirs

Name of river	Name of dam (reservoir)	Catchment area [km ²]	Gross capacity [10 ⁶ m ³]	Effective capacity [10 ⁶ m ³]	Purpose ¹⁾	Year of completion
Geumho	Yongchon	235.0	96.4	81.4	I, W	1980
Donghwa	Gongsan	60.1	5.5	4.5	W	1981
Shin	Gachang	43.0	9.1	8.9	W	1984

Major Interbasin Transfer

Name of transfer line	Names of rivers and places connected		Length [km]	Maximum capacity [m ³ /s]	Purpose ¹⁾	Year of completion
	From	To				
Nakdong-Taegu City Conveyance Channel	Nakdong River	Taegu City	12	13.9	I, W	1985
Unmoon Dam-Taegu, Kyongsan, Yongchon City Conveyance pipe	Milyang River	Taegu, Kyongsan, Yongchon Cities	48	4.4	W	1994
Yongchon Dam Diversion Hyungsan Basin Conveyance Channel	Geumho River	Hyungsan River	38	2.5	I, W	1980
Imha Dam Diversion Geumho Basin Conveyance Channel	Bandyun River	Geumho River	57	5.2	N, W	1994

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

5.4 Major Floods and Droughts

Major Floods at Dongchon [1 529 km²]

Date	Peak discharge [m ³ /s]	Rainfall [mm] Duration	Meteorological cause	Dead and missing	Major damages (Districts affected)
1970. 7.17	1 983	162 7.15~7.18	Typhoon	3	Kyongsan, Yongchon City
1978. 6.20	1 519	214 6.19~6.21	Typhoon	1	Taegu, Kyongsan City
1982. 8.14	2 434	154 8.12~8.14	Typhoon	2	Taegu City
1984. 9.03	1 735	127 9.01~9.04	Typhoon	1	Kyongsan, Yongsan City
1985. 9.19	1 439	178 9.16~9.20	Typhoon	1	Kyongsan City
1986. 6.24	1 625	192 6.22~6.25	Typhoon		Taegu City
1988. 9.05	1 810	229 9.02~9.05	Typhoon	4	Taegu, Kyongsan City
1990. 8.27	1 091	154 8.26~8.28	Typhoon	1	Taegu City
1992. 8.29	1 324	136 8.27~8.29	Typhoon		Taegu, Kyongsan, Yongchan City

Major Droughts

Period	Affected areas	Major damages and counteractions
1967.10 ~ 12	Taegu, Kyongsan Yongchon City	Water supply cut ratio at the first stage: 10%
1968. 1 ~ 9	Taegu, Kyongsan Yongchon City	Water supply cut ratio at the first stage: 10% at the second stage: 12%
1975. 6 ~ 9	Taegu, Kyongsan City	Water supply cut ratio at the first stage: 15%
1976. 6 ~ 9	Kyongsan Yongchon City	Water supply cut ratio at the first stage: 20%
1979. 9 ~ 11	Taegu, Kyongsan City	Water supply cut ratio at the first stage: 15%
1982. 8 ~ 11	Kyongsan, Yongchon City	Water supply cut ratio at the first stage: 20%
1994. 7 ~ 11	Taegu, Kyongsan Yongchon City	Water supply cut ratio at the first stage: 10% at the second stage: 15%

5.5 Groundwater and Water Quality

River Water Quality ¹⁾ at Dongchon²⁾ in 1993

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pH	7.5	7.4	7.5	7.5	8.4	7.7	7.4	7.5	7.4	7.3	7.4	7.5
BOD [mg/l]	1.9	1.5	3.2	4.5	8.1	4.5	4.3	3.4	3.3	1.7	1.8	2.0
COD _{Mn} [mg/l]	1.5	1.8	2.7	4.6	6.8	7.7	4.4	4.2	4.1	1.8	1.5	1.8
SS [mg/l]	13	18	17	16	13	20	60	12	44	20	18	15
Coliform group ³⁾ [MPN/100ml]	2.5 x 10	2.4 x 10	1.2 x 10 ²	1.4 x 10 ²	1.5 x 10 ²	2.4 x 10 ²	2.4 x 10 ³	2.3 x 10 ²	7.5 x 10 ²	2.4 x 10 ³	1.8 x 10 ²	1.1 x 10 ²
Discharge ⁴⁾ [m ³ /s]	2.01	1.86	2.12	2.45	1.82	7.80	5.70	5.30	4.06	6.17	4.25	3.37

- 1) Observed once a month on a dry day normally several days after rainfall.
- 2) Location near Chongju City 14 km from the river mouth.
- 3) Measurement method: BGLB (brilliant green lactose bile) method.
- 4) Discharge on the water quality observation date.

6. Socio-cultural Characteristics

The Geumho is located at the centre of the main highway and railroad between Seoul and Pusan, a coastal city. The capital city of the basin, Taegu is the third largest city in Korea and the main centre of political, economic, social and cultural activities in "Yeungnam", or the south-eastern part of Korea. This basin is also near the old capital city, Kyongjoo, of Shilla dynasty which is one of the most famous scenic and cultural areas in Korea.

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