Ministry of Government Administration and Home Affairs

Republic of Korea

Country Report

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2.1. Statistics of the Last 10 Years

Table 1 Natural Disaster Damages for the Last 10 Years

item year	Casualty (person)	Evacuated Person (person)	Inundated Area (ha)	Building (10^6 $)	Ship (10^6 $)	Farmland (10^6 $)	Public Facilities (10^6 $)	Others (10^6 $)	Total (10^6 $)
1988	143	5,053	17,987	0.5	1.2	8.8	69.0	22.1	101.6
1989	307	92,593	121,060	4.9	4.4	12.2	170.2	266.7	458.4
1990	257	203,314	124,276	7.7	2.5	37.4	230.2	263.5	541.3
1991	240	29,573	61,173	4.1	1.8	32.0	247.9	36.5	322.4
1992	40	965	13,969	0.1	0.9	1.2	12.5	5.4	20.0
1993	69	13,779	58,489	1.0	8.8	8.4	127.8	18.2	164.3
1994	72	11,852	6,275	0.5	3.7	9.1	72.2	42.3	127.8

1995	158	30,408	79,253	4.1	5.8	50.9	361.9	78.2	501.0
1996	77	18,686	47,968	12.5	0.7	45.1	278.8	65.5	402.5
1997	38	6,296	45,774	1.6	2.3	9.3	121.9	24.0	159.1
Total	1,401	412,519	576,223	42.2	37.2	243.6	1933.2	997.0	3253.3
Average	140	41,252	57,622	4.2	3.7	24.4	193.3	99.7	325.3

2.2. Flood Damage in July and August, 1998

1. Introduction

A global anomaly in the atmospheric circulation has been caused by the effect of El Niño this year. The effect was revealed by heavy rains in some regions, especially in Japan, Korea, and Yangtze River area in China. In Korea, there were intensive heavy rains at most parts of the country between July 31 and August 18, 1998, due to the climatic disturbance and humid air inflow from Yangtze River area. The intensive rains caused wide spreading floods, which resulted in over 300 in deaths. More than 180 thousand residents were evacuated and the total property damage was more than about $923 million because of the floods. The direct cause of the floods was unusually high hourly precipitation.

During the floods, the damage was collected by local government offices and reported to Korea National Disaster Prevention and Countermeasures Headquarters (KNDPCH) where rapid damage analyses and proper counteractions were conducted. Also, Korea National Institute for Disaster Prevention (KNIDP) and other organizations performed damage investigations including aerial photographing on flooded areas.

2.2.2. Hydrological Condition of Korea

Korea is located in a monsoon region and experiences several Typhoons every year. The annual average precipitation is about 1,274 mm, and most of the precipitation occurs during the rainy summer season between June and September. River reaches in Korea are relatively short and the channel slopes are relatively steep. Therefore, flooding occurs quickly and the peak discharge is high due to the topographical conditions and the torrential rainfall. The flow variations also are very large and the coefficient of the river regime, expressed by the maximum over minimum discharge, usually ranges from 100 to 700.

2.2.3. Characteristics of Rainfall between July 31 and August 18, 1998

The "August Flood" was caused by localized and sudden rainfalls which had nicknames like "football" (unpredictable where to move) or "guerilla" (unpredictable when to appear). In fact, heavy rains appeared suddenly in various places in Korea such as Seoul, Kanghwa, Phaju, Tongduchon, Uijungbu,

Sangju, Uisung, Pouen, Gurye, Soonchon, and etc.. Precise forecasting for this kind of sudden rain was almost impossible, and Korean Meteorological Agency is trying to provide more accurate weather forecasting adopting a supercomputer. Also, more damage was added by condensed precipitation over a short period of time, especially in mountainous and/or agricultural area.

Unusual characteristics of the "August Flood" can be found when observe the precipitation logs of Kanghwa, Seoul, and Soonchon areas. A total rainfall of 481 mm was accumulated in Kanghwa for just 11 hours on August 6, 1998, which was more than 47 day precipitation (400 mm) in the area this summer. This is the highest record of daily precipitation in August since Korean Meteorological Agency starts the recording in 1904. The second highest record in August is 439 mm in Pusan area August 23, 1991. Regardless of the month, Changheung has the highest daily precipitation record of 547 mm, and the second place goes to Puyeo with 518 mm. Even though Kanghwa is the third highest based on the daily precipitation record, the amount of rainfall between 10 p.m. August 5 and 6 a.m. August 6 indicates that it is no less than the highest record.

Soonchon, on the other hand, had a record-breaking hourly precipitation of 145 mm at 9:50 p.m. July 31. The previous hourly record was 119 mm in Seoul August 5, 1942. 10-minute rainfall of Soonchon area, 43 mm, was close to the highest record of 47 mm recorded in Seoul on June 22, 1956

In Seoul on August 8, a total precipitation of 333 mm was recorded which was the second highest following 355 mm on August 2, 1920. Table 2 shows the result of rainfall frequency analysis of August 1998 for Seoul and Kyungi Area.

Table 2 Rainfall Frequency Analysis of August 1998 for Seoul and Kyungi Area

AREA	1 HOUR*		2 HOURS*		6 HOURS*		24 HOURS*		NOTE
	P (mm)	R(year)	P (mm)	R(year)	P (mm)	R(year)	P (mm)	R(year)	
Kanghwa	112.0	150	216.5	1000↑	466.5	1000↑	619.5	1000↑	E
Uijungbu	99.0	60	190.0	600	340.0	1000↑	406.5	100	E
Tongduchon	86.5	30	144.0	90	242.5	200	354.3	40	I
Inchon	61.0	10	80.0	5	93.4	5	157.7	5	I
Seoul	60.5	10	99.0	10	173.0	20	361.5	50	I

note: * Duration, P = Precipitation, R = Return Period, E = Extrapolation, I = Interpolation

It can be shown that for Kanghwa and Uijungbu area the total amounts of precipitation well exceed the return period of 20 years for designing drainage system, and the design frequency of 100 years for urban stream construction. It also can be seen that there was a severe local variation. The differences in precipitation were quite big, although the measuring points were close each other.

2.2.4. Summary of the Flood Damage

The flood damage occurred between July 31 and August 18 was severe, and the pattern of damage was somewhat different from previous ones. Most parts of Korea, except Cheju Island, suffered great losses by the flood. According to KNDPCH the total property damage was more than about $923 million that is the second severest in the history. The first one is $1.1 billion (corrected for current value) which occurred in July 1987 by Typhoon Thelma.

More than 88 thousand buildings and 71,500 ha have been submerged and 7,413 homes were evacuated. The total damage was more than twice of average yearly damage. Figure 1 presents submerged areas and property damages between 1977 and 1998.

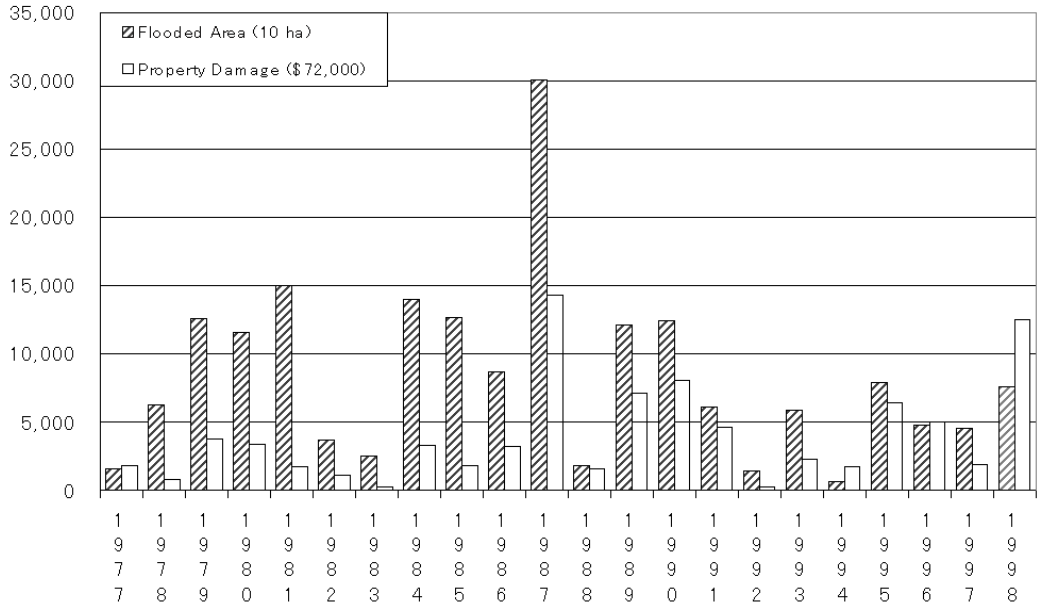

Figure 1 Submerged Areas and Property Damages between 1977 and 1998

286 people were dead and 38 were missing. This is the most severe one in the last 10 years. Most people were dead because of landslide in Kyungi area and Flash flood in Chiri mountain area.

In general, a disaster area is declared when the damage is more than about $900 thousand, $600 thousand, or $350 thousand in capital, urban, or local area, respectively. Regardless of administrative district, a town with a population of more than 300 thousand is declared as a disaster struck area when the damage is more than $600 thousand. During the "August Flood", 107 places were declared as disaster areas and Figure 2 shows their locations and relative position of Korean peninsula.

The percentages of the damage for individual facility or structure are shown in Figure 3. The largest damaged item is "River" which is almost 20% of total damage. Next items follow as "Road" (14%) and "Creek" (12%).

5. **Conclusions**

Because of the flood occurred between July 31 and August 18, 1998, the total property damage was more than about $923 million that is second severest in the Korean history. It is pointed out that citizens should have more responsibilities for their own lives and the government should have more comprehensive countermeasures for disaster prevention. The "August Flood" warned us that the flood management is a very essential part of disaster mitigation and that we should be prepared for next big ones. Moreover, after analyzing the causes of the damage precisely, extensive river disaster counterplan needs to be addressed.

Figure 2 Locations of Disaster Areas by the "August Flood" and Relative Position of the Korean Peninsula

2.3. Summary

- During the period of September to December in 1997, blizzards, typhoons, rainfalls had affected Korea Peninsula. As a result, 15 people died and U.S. $13 million worth of property damages occurred.

- In 1998, there were 13 disasters, including floods, typhoons, and tidal waves from June to August, resulted in 327 casualties and property damage of about U.S. $2 billion.

- During the period from September 1, 1997 to August 31, 1998, the total damage caused by 17 natural disasters were 324 casualties and U.S. $1,019 million property damages. (Detailed damages are given in Table 3).

Table 3 Total Damages caused by Natural Disaster during the Period from Sep. in 1997 to Aug. in 1998

Classification	Units	Sep.-Dec., 1997	Jan. - Aug., 1998	Total
Casualties (Dead or Missing)	Person	15	327	342
Evacuated Person	Family/ Person	910/3,460	7,686/25,481	8,596/28,941
Farmland Lost or Buried	ha	2	7,978	7,980
House Destroyed or Damaged	Unit	2	2,917	2,919
Property Damage	U.S. $ million	16	1,006	1,019

3. Disaster Prevention and Preparedness Activities

3.1. Implementing the Disaster Prevention and Preparedness in 1998

To reduce the loss of life, property damage, and economic disruption caused by natural disasters such as floods and windstorms during the rainy season, the Korean government has designated the period from March 1 to May 31 in 1998 as "Disaster Preparedness Period" and performed several programs during this period.

a. Inspection and Maintenance of the Disaster-Prone Areas

- Inspecting and maintaining 416 Disaster-Prone Areas vulnerable to inundation, collapse, and isolation by typhoons and floods.

b. Inspection and Maintenance of Large-Scale Construction Sites

- Preparing the "Disaster Preparedness Plan" and assigning government officials to maintain 875 large-scale construction sites such as subways, golf courses, dams, and etc..

c. Inspection and Maintenance of Disaster Prevention Facilities

- Inspecting and repairing 6,311 disaster prevention facilities including retaining walls, embankment, reservoirs, and etc.

d. Securing Equipment and Facilities for Emergency Countermeasures

The equipment and facilities for emergency countermeasures had been secured based on the average amount needed in the last ten years.

- Securing disaster prevention equipment such as pile, bag, and etc..
- Securing goods for the relief of evacuated citizens.
- Securing rescue equipment such as helicopters, ships, life jackets, ambulances, wireless, and etc.

e. Saving Fund for Natural Disaster Countermeasures

- The total of U.S. $ 116 million is laid aside in 16 cities and 232 districts for predisaster prevention activities and emergency rehabilitation during the severe natural disaster.

3.2. Disaster Prevention Education, Drills, and Public Relations

a. Disaster Prevention Education

- 42,984 staff members were educated from March 9 to May 9 in 1998 to enhance their abilities to deal with natural disasters. The program included planning, managing critical situations, reporting damage, working on recovery plans, and studying relevant laws.

b. Drills and Practice Emergencies

- To take proper actions immediately for disaster prevention together with other community residents and related organizations, exercise under computer-simulated disaster conditions, comprehensive exercise for disaster prevention, and practice emergencies specific to each region were carried out during the period from May 12 to May 15 in 1998.
- Exercise under computer-simulated disaster conditions:
- To increase the ability for managing disasters, the exercise under computer-simulated disaster conditions, which related authorities participated in, was carried out from May 12 to 14 in 1998.
- Comprehensive exercise for disaster prevention:

- On May 15, 1998, comprehensive exercise for disaster prevention was carried out at the Namhan river basin under the assumption of hit by typhoon JANIS (July 1995) again. The program of drills included life saving, emergency relief, rehabilitation, and etc..
- Practice emergencies specific to each region:
- Local governments carried out their own practice emergencies specific to each region on 15, May in 1998.

- To cope with earthquakes effectively, the government carried out exercise under computer-simulated earthquake conditions on April 15, May 14, and September 15, 1998.

c. Public Relation for Disaster Prevention

- Korea has designated May 25 as "National Disaster Prevention Day" to promote the public participation and awareness of disaster prevention.

- The main events on the "National Disaster Prevention Day" are as follows;

  ・Inspection of disaster prevention facilities and equipment

  ・Drill and campaign for disaster prevention

  ・Photo display of disaster-struck areas and their recovery processes

  ・Contest for disaster prevention posters

3.3. Implementing the Disaster Prevention Plan

- To cope with the disasters which are getting varied and larger in scale, the government has formulated the Basic Five-Year Disaster Prevention Plan and the Yearly Disaster Prevention Action Plan.

- During the Fifth Basic Disaster Prevention Plan Period (1997?2001), the government will invest more than about U.S. $22 billion to 22 key items such as afforestation flood control, disaster prevention, technology development, and etc..

- According to this plan, the government has invested more than U.S. $4 billion to 22 key items in 1998.

3.4. Risk Assessment Evaluation System of Disaster Impact(RAESDI)

- The RAESDI is designed to protect the lives and property living in the downstream from the impacts of large scale development.

- Since the RAESDI was introduced on October 21, 1996, a total of 50 projects had been deliberated by the end of August 1998. The result of deliberation was as follows; 37 projects agreed, 3 projects insufficient, 10 project drafts analyzed.

3.5. Implementing the Improvement of Disaster Prone Areas

- Korea chose 416 sites most vulnerable to inundation, collapse, and isolation by typhoons and floods, and labeled them as Disaster Prone Areas. A total U.S. $762 million will be invested for full improvement from 1998 to 2007.

- According to this plan, a total of U.S. $59 million was invested to improve 90 disaster prone areas as ongoing projects in 1998.

3.6. Implementing the Improvement of Small Rivers

- Small rivers in Korea are vulnerable to overflow and one of the main causes of flooding. Thus, over the next 22 years ('95 to 2016), 25,684㎞ is earmarked for improvement with the investment of more than U.S. $8 billion. The first step is to refurbish 4,450㎞ from 1995 to 2004 at the cost of about U.S. $2 billion.
- In 1998, 250㎞ of small rivers were refurbished at the cost of U.S. $69 million.

3.7. Establishment of Automatic Rainfall Warning Systems

During the summer season there have been casualties in valleys and riverbanks because of heavy rains. Automatic rainfall warning systems, which can detect the amount of precipitation in upstream, is being established at 108 sites from 1996 to 2003, so that campers can take early warning.

- In 1998, automatic rainfall warning system has been set up at five sites and the cost was about US $800 thousand.

3.8. Management of Disaster in 1998

- The Korean government has designated the period from June 15 to October 15 as "Disaster Countermeasures Period" and Korea National Disaster Prevention and Countermeasures Headquarters (KNDPCH) and local competent authorities are ready to manage possible disasters during this period 24 hours a day.

- During the period from July 31 to August 18, 1998, humid air inflow from Yangtze river caused heavy rainfalls of 1,274 mm, which is almost two third of a whole year.

- Even though KNDPCH and other authorities tried to minimize the damages, including efforts for emergency rescue and conducting proper counteractions, the total damage exceeded US $ 962 million which is the severest damage cost in the Korea history.

- As mentioned before (section 1), the damage was mainly caused by sudden and localized rainfalls for just two weeks.
    - Soonchon city in Chunnam province had a record-breaking hourly precipitation of 145 mm at 9:50 p.m. July 31.
    - A total rainfall of 1,539 mm was accumulated in Tongdaemoon area of Seoul from July 31 to August 16.

- A global anomaly in the atmospheric circulation caused by the effect of El Niño in 1998 resulted in inexorable damages in most parts of Korea.

3.9. National Institute for Disaster Prevention

- National Institute for Disaster Prevention (NIDP) was established on September 2, 1997 to conduct systematic and scientific researches in the field of disaster prevention.

- NIDP was performed 9 research projects in 1997 and is carrying out 17 research projects such as「Development of Guidelines for Design of Flood Storage Reservoirs」,「Study on the Development of the Flood Insurance Program」,「Basic Study for Establishment of the Small River Design Guidelines」, and etc..

4. Plans for 21st Century

4.1. Refinement and Consolidation of Related Regulations

- There are currently about 80 different regulations on land development, which are regulated by different authorities and do not routinely consider the disaster impact by land development.

- Before any development is carried out, it is desired to consider disaster factors that may cause severe damages. It is planned to study and develop appropriat regulations for removing any potential factors in advance according to the size of development and controlling authorities. For instance, to reduce the surface runoff of rainfall the

study may include several topics such as rainfall storage detention facilities of residential area, infiltration wet wells of roads, and retention basin and underground infiltration facilities of public parking lot and/or school ground.

- Implementation of flood insurance program will also be considered to reduce the impact of disasters on individual property owners by spreading these losses over a large base.

4.2. Investment on River Side Infrastructures for Disaster Mitigation

- The investment for flood control has been inconsequential (0.07% of GNP) compared to that for other SOCs. A balanced investment is required for effective disaster mitigation.

4.3. Systematic and Scientific Researches for Disaster Prevention

- The function and the number of personnel of the Korean National Institute for Disaster Prevention need to be increased for systematic and scientific researches for disaster prevention.

4.4. Active International Cooperation

- The Korean government will actively participate in international conferences, provide joint research projects to various organizations, share the information, and offer accumulated database or technology to other countries when asked.