INTEGRATED FLOOD MANAGEMENT IN KOREA

Distinguished Professor, Yeungnam University, Republic of Korea
President, International Hydrologic Environmental Society (IHES) and Korea Federation of Water Science & Engineering Societies (KFWSES)

Soonkab CHUNG, Ph.D.
Director-General
Forecast Bureau, Korea Meteorological Administration
Republic of Korea
The main typhoon season, which affects Korea, normally runs between June and September. Korea is normally hit directly by 1 to 3 heavy typhoon storms per year with most events occurring in August.
Rainfall Intensity has been increased significantly, especially for higher intensity events.
The rivers in Korea are relatively short and channel slopes are relatively steep. The river reaches are short and drainage areas are small in Korea compared with other major continental rivers. The channel slopes are relatively steep upstream because of steep mountains and deep valleys in the uplands.

Floods occur quickly and peak flood discharges are enormous. Due to the topographical conditions and torrential rainfalls, the hydrographs of rivers in Korea are very sharp and peak flood discharges are enormous compared with other comparable rivers in the continent.
Characteristics of the Rivers in Korea (2/2)

- **Flow variations are high.**
  - The coefficients of the river regime, expressed by maximum discharge over minimum discharge for rivers in Korea usually range from 100 up to 700.
  - This large variation in the flow discharge causes serious problems in river management concerning flood control and water use.
Korea Main River System

Han River: 25,954 km² / 494 km
- 3 Multi-Purpose Dams
- 6 Hydro-Power Dam
- 1 Flood Control Dam

Nakdong River: 23,384 km² / 510 km
- 5 Multi-Purpose Dams

Geum River: 9,912 km² / 398 km
- 2 Multi-Purpose Dams

Yeonsan River: 3,468 km² / 137 km
- 3 Irrigation Dams

Seomjin River: 4,960 km² / 224 km
- 2 Multi-Purpose Dams
Water, Water, Water ... Flood
Floods in a Recent Decade

- Collapse of Yeoncheon Dam in 1996
- Flooded Paju City in 1998
Floods in a Recent Decade

Railway Bridge Broken by Typhoon Rusa in 2002

Village Flooded by Typhoon Maemi in 2003
Flood Damages

- Property Loss in million US Dollars
- Life Loss


Graph showing the comparison of Property Loss and Life Loss from 1993 to 2002.
FLOOD RISK FACTORS
Risk Factors (1/4)

- Abnormal weather events due to global warming
- Rapid urbanization and industrialization
- Insufficient infrastructure for flood defense
- Lack of social systems, cooperation between sectors and public participation
Risk Factors (2/4)

- Air temperature has risen significantly, higher than the global average.
- Rainfall intensity has been increased significantly, especially for higher intensity events.
- Number of daily rainfall events.
- Abnormal weather events due to global warming.
For the last four decades, population increase two times; GDP increased 2,500 times; and urban ratio increased more than two times.

**Rapid urbanization and industrialization**
Risk Factors (4/4)

Insufficient infrastructure for flood defense

- Lack of fund for flood control
- Difficulty in securing investment funds for middle and small-sized streams
- Insufficient flood control facilities in urban areas
- Deficient improvement of stream management system
- Deterioration of stream functions
INTEGRATED FLOOD MANAGEMENT
Flood Forecasting and Warning

- Concept of Flood Forecasting and Warning
  - Storm monitoring and forecasting
  - Flood information monitoring and transmitting
RAINFALL FORECAST
- KMA DIGITAL FORECAST -

Quantitative forecast for 12 watershed forecast elements every hours out to 48 hours based on 5 km grid scale over the Korea peninsula.

- Innovation toward creating forecast system
  - Spatio-temporally detailed forecast
  - Quantitative values for Socio-economically applicable products
  - Weather forecast services going along with IT-ERA
  - Enhance application potential of forecast products
    → application for partners, satisfaction for customers

- Integration of Korea Meteorological Administration
  Scientific knowledge and technologies for construction digital forecast
1. Use numerical weather prediction output

2. Generate 5 km digital forecast grids

3. Apply statistical forecast model to specific stations

4. Edit temporal and spatial modification by forecaster

5. Distribute digital forecast contents from DB system
Benefits of Hydro-meteorological Forecast

**WHERE? WHEN? HOW MUCH?**

- **Preservation**
  - Provide forecasts in exchange for reservoir scheduling information to produce hydrologic forecast
  - Provide forecasts in exchange for reservoir scheduling information to produce hydrologic forecast

- **Usage**
  - Provide the best support for national water resources decision makers for drinking, washing, and agricultural information
  - Provide the best support for national water resources decision makers for drinking, washing, and agricultural information

- **Prevention**
  - Protect life and property from the threat of weather-related disasters
  - Provide sufficient warning time to the communities

**How to Use Water Resource and Water Environment**

- **In Natural System**
- **To Natural Disaster**
- **For Public Utilities**

- **Timely and accurate forecasts, and warnings**
- **Detailed forecast information to protect life and property**

⇒ Enhanced the national economy using hydro-meteorological information
Flood Forecasting and Warning

Administrator of Dam
- To make plans for releasing water from dam
- To start releasing water

Flood Control Office
- To estimate possible outflow by divided basin areas
- Flood forecast
- Announcement and cancellation of flood forecast

Central Disaster Prevention and Safety Countermeasures Headquarters

Announcement to the Public (through broadcast or newspaper)

Related Agencies

Regional Disaster Prevention and Safety Countermeasures Headquarters in Cities or Provinces

Residents in the regions

Minister of Ministry of Construction & Transportation

Approval for releasing water from dam

Report of results

Telemetering Observation Station
- Monitoring Stations for water level and rainfall
- Water level of dam and volume of release

Notification of plans for releasing water from dam

Request of approval for releasing water from dam

Notification of flood forecasting announcement

Notification of results

Approval for releasing water from dam

Report of results
Flood Forecasting System (KFWMS)

- Establishment date of KFWMS: Since 1974
- Objective Basin: 5 major rivers, 6 rivers, 7 small rivers
- Organization of KFWMS: 4 Flood Control Office
- Operating Flood Forecasting Models: Hydrological & Hydraulic Flood Forecasting

Map showing locations of Major River, Middle River, and Small River.
Flood Forecasting System

- Real-Time Monitoring System
- Flood Forecast Module
- Hydrologic Database System
- River Selection Option
Flood Management with Radar System
Flood Control

Flood Control Procedure (1/2)

- Rainfall Forecast
- Runoff Analysis
- Inflow Estimation
- Reservoir Operation Simulation
- Decision Making
- Gate Opening & Releases
Flood Control Procedure (2/2)

- Rainfall Forecast
- Runoff Analysis
- Inflow Estimation
- Reservoir Operation Simulation
- Decision Making
- Gate Opening & Releases
- Flood Releases

Video Conferencing

WROC

Field Office
Flood Control Assessment

Analysis for Upstream

Forecasting

Flood Control of Dam

Analysis for downstream

Reduction of Water Level
Flood Map System
Objectives

By 2007, completing the Basinwide Integrated Flood Management Plans for the 13 river basins in the nation to defend the flood from the extreme rainfall;

- Upgrade the flood management paradigm for the abnormal climate change
- Overcome the deficiency of flood control capacities due to the limitation of dam construction and river flood protection facilities
- Raise the storage capacities of flood in the basin
- Establish the measures for the urban population and properties in the flood prone areas
- Establish the integrated optimal operation system of dams and flood control facilities in each basin
Main contents (Basic direction) (1/2)

- Distributing flood control functions into both river channel and basin for the present and future flood flow by changing the flood control policy.

- Increasing the flood storage capacities in upstream areas by the construction of riverside detention reservoirs or by using floodplain areas, and accordingly, increasing the safety level of flood management in whole river basin and decreasing the flood control volume in downstream channel reach.

- Spatial and master planning for the flood control including storages, rainwater capture systems, levees, pumping stations and landuse plan for their construction and share of flood flow.
Main contents (Basic direction) (2/2)

- Planning, development and maintenance of optimal integrated operation system for the flood control

- Building flood control plans of both structural and nonstructural measures appropriate to the regional characteristics

- Examining the links with higher level or other related plans as well as the links of the facilities with other infrastructures such as railways, roads and bridges
Control of Flood Disasters

- **Flood Scale**
  - Extreme Flood
  - Excess Flood
  - Design Flood

- **Allocation**
  - Stream Channel
  - Stream channel + Basin

- **Measure**
  - Non-structural Measure
  - Structural Measure

- **Planning**
  - Basin-wide Comprehensive Integrated Plan
  - River Improvement Basic Plan

**Control Strategies**

- Non-structural Measure
- River Improvement Basic Plan
- Non-structural Measure Planning
THANK YOU FOR YOUR ATTENTION!!