

Development and Application of Decision Making Support System for IWRM based on ICT

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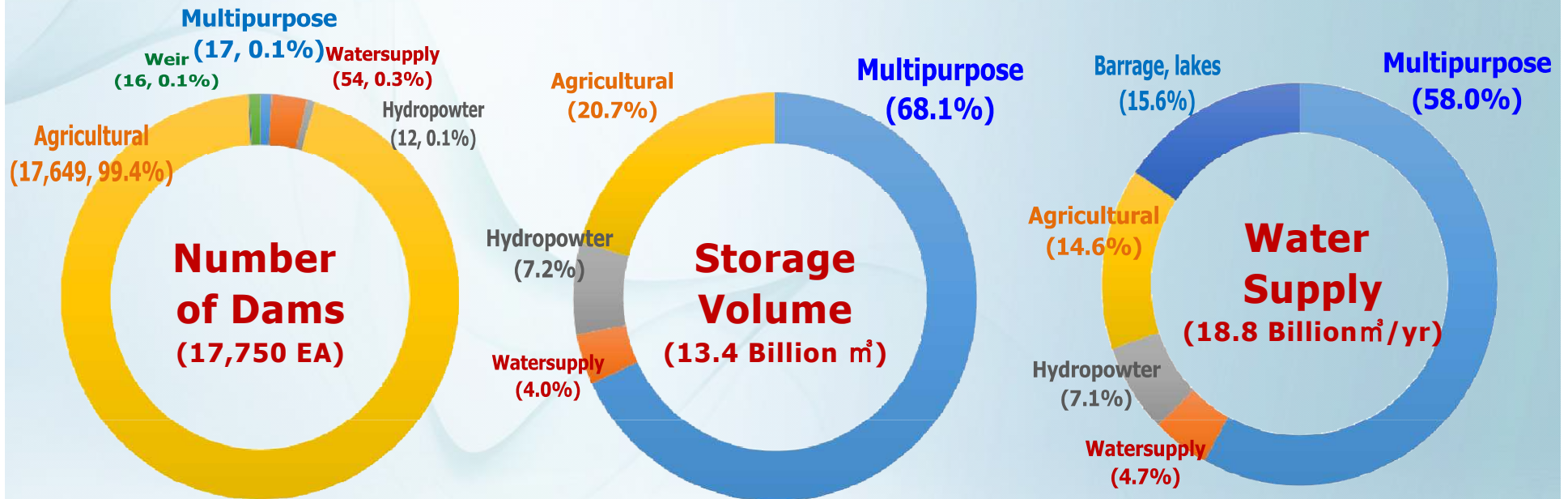
How can we mitigate water-related damage?



The **KEY** to implement IWRM

1. Water Resources in Korea

- Dams in Korea



■ Roles of K-water : Operating 17 Multipurpose, 14 water supply, 2 flood control dams & 16 weirs

	Storage Volume	Water Supply	Flood Control Capacity	Hydro Power Generation
Korea	13.4 B m³	18.8 B m³/yr	5.2 B m³	1,750MW
K-water	9.3 B m³	12.2 B m³/yr	4.9 B m³	1,061MW
Percentage(%)	69%	65%	95%	61%

* K-water covers 48%(17.5 Million m³/day) of water works capacity of Korea (37.2 Million m³/day)

2. Decision Making Support System for IWRM

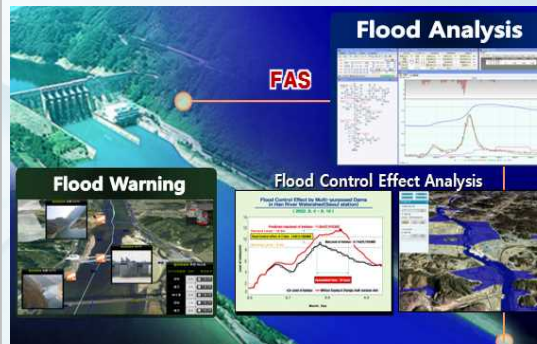
Precipitation Forecast System

Rainfall Forecast for 58 Dam & Weir basin, 4 times/day



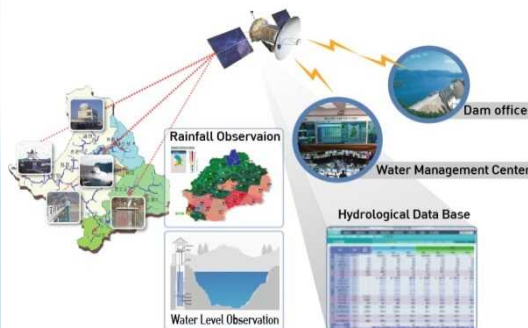
Flood Analysis System

Reservoir, River Flood Analysis
< Downstream Effect Analysis >



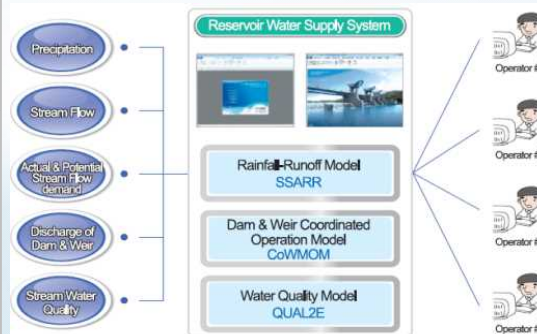
Real-time Hydrological Data Acquisition & Processing System

Real time Data gathering from 446 Hydrometric St. and 232 CCTV



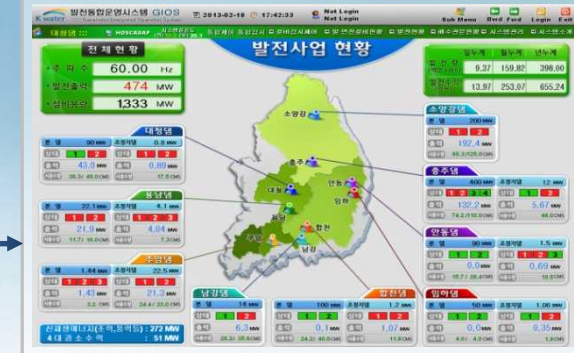
Reservoir Water Supply System

Water Demand & Quality Prediction
< Optimized Water Supply Plan >

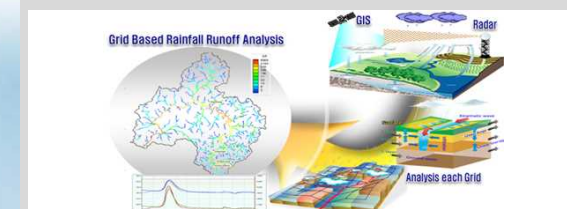


Generation Integrated Operation System

Operate 25 Power plants (78 Generators)
< Remote Control, Monitoring >



K-water Distributed Run-Off Model

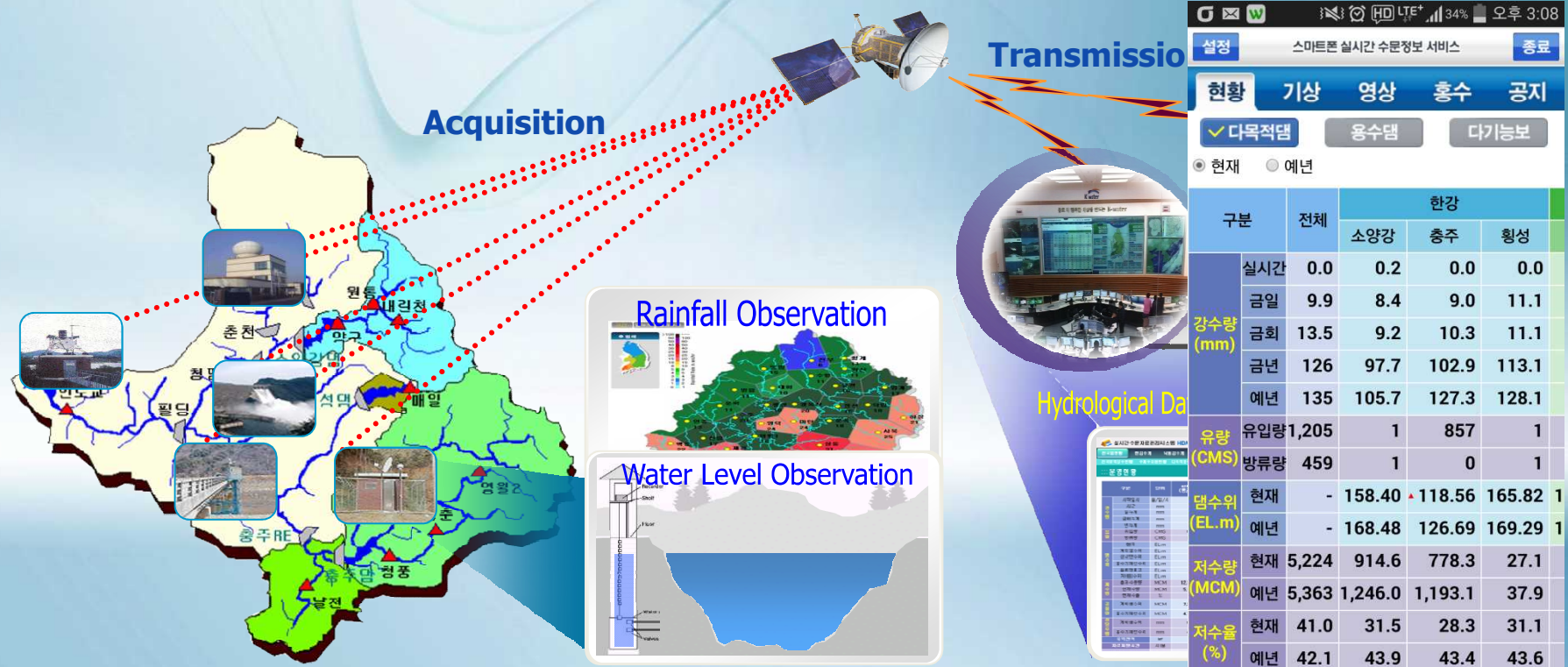


2. Decision Making Support System for IWRM

1. Real-time Hydrological Data Acquisition and Processing System (RHDAPS)

Gathering and Processing Real-time Hydrological Data

- (Gathering) Rainfall, water level, discharge & water quality data from 466 Stations
- (Data Management) 1 minute real-time base (1, 10, 30, 60 min)
- Dual Communication Network (Satellite + CDMA)



2. Decision Making Support System for IWRM

2. Precipitation Forecasting System (PFS)

Provide Precipitation Forecast for Dam/Weir Operation

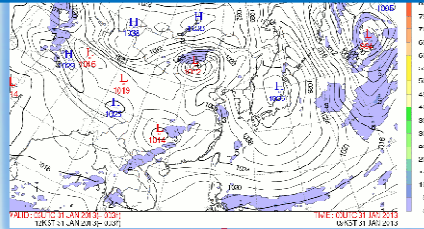
Collection of weather data

PFS run on HPC
(4times/1day, 5days forecast)

Precipitation forecast



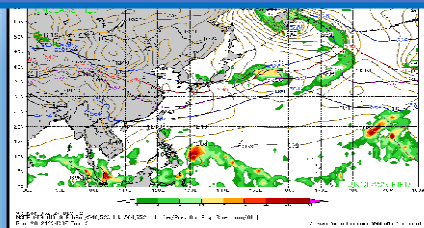
Korea Meteorological Administration (KMA)



Collect Weather Data K water
Temperature, Humidity, etc



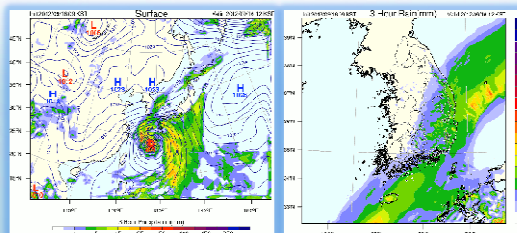
National Oceanic and Atmospheric Administration (NOAA)



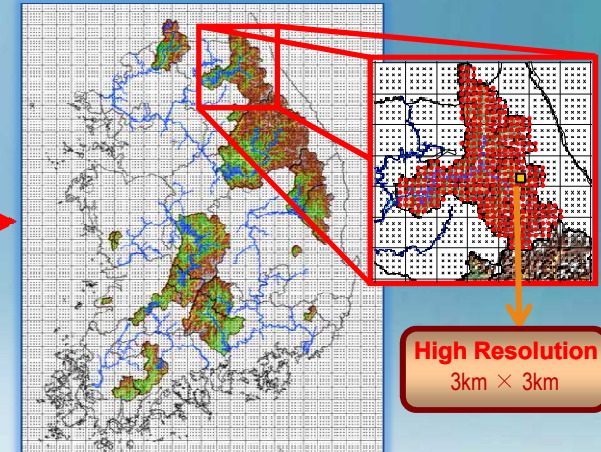
High Performance Computing (HPC)



Weather chart

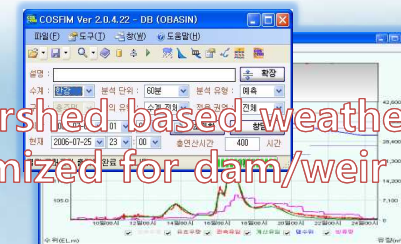


Calculate precipitation



High Resolution
3km × 3km

Flood Analysis System



Watershed based weather forecast
Optimized for dam/weir operation

2. Decision Making Support System for IWRM

3. Flood Analysis System (FAS)

Precipitation Forecast
Real-time Data Observation

Flood Analysis

Flood Release Schedule

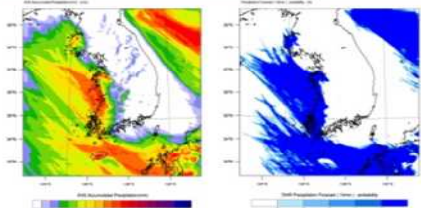
Channel Routing

Decision Making

Gate Open / Warning

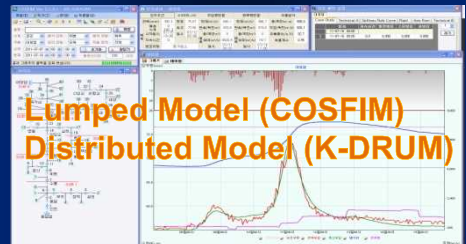
PFS

Precipitation Forecasting



FAS

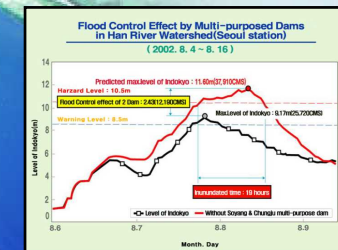
Flood Analysis



Flood Warning

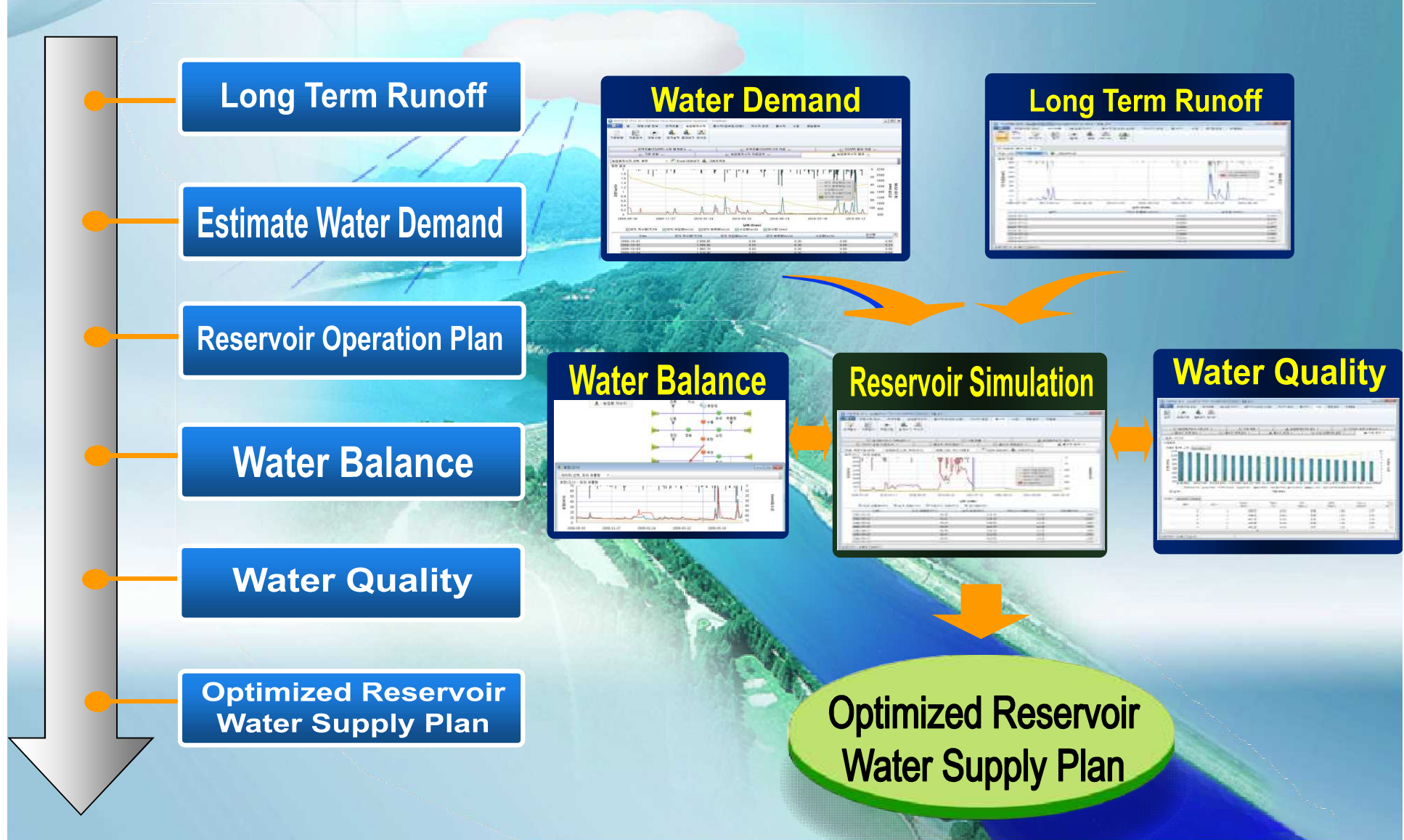


Flood Control Effect Analysis



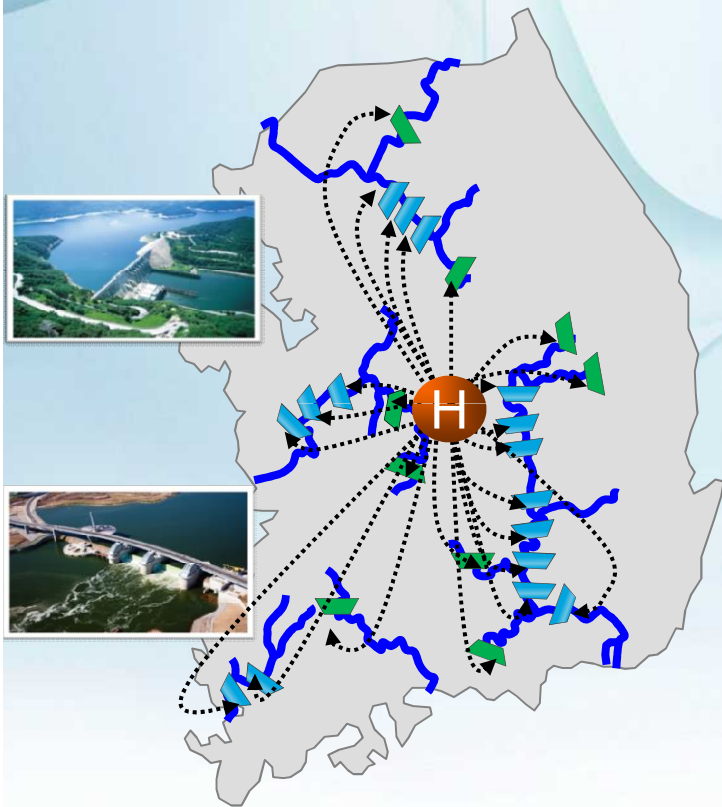
2. Decision Making Support System for IWRM

4. Reservoir Water Supply System (RWSS)



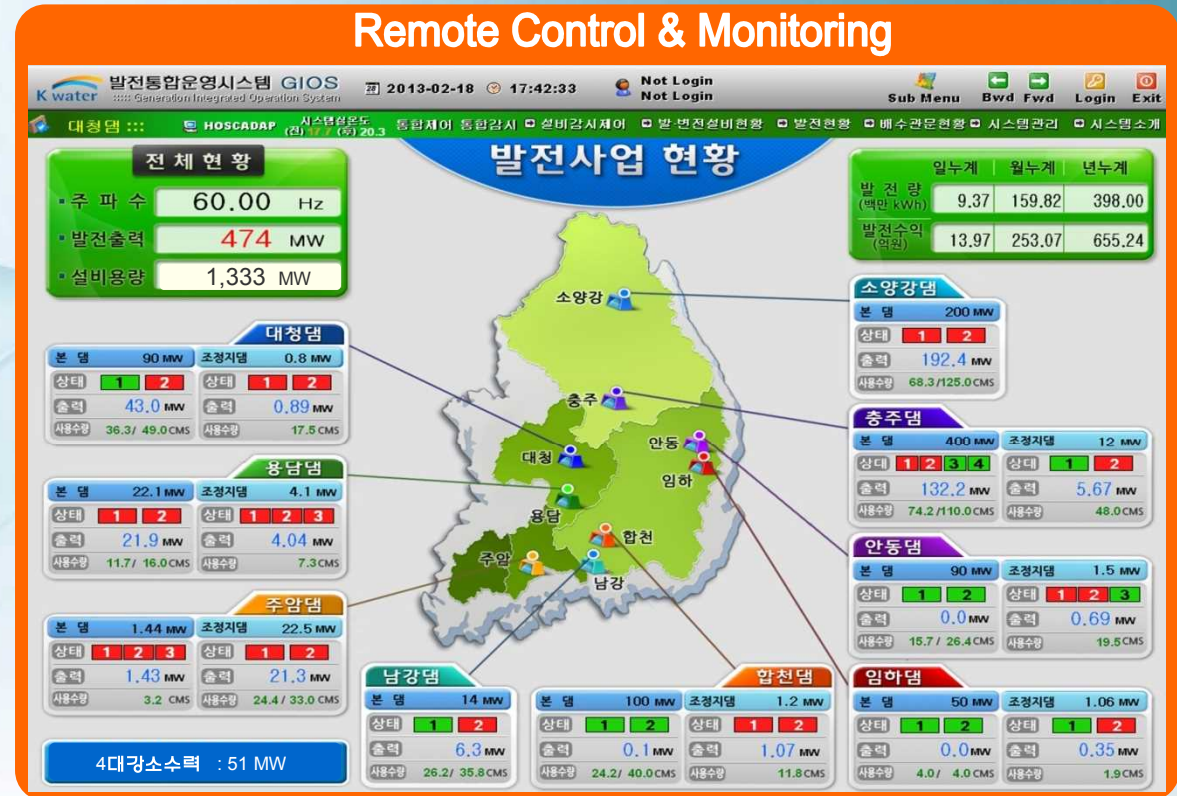
2. Decision Making Support System for IWRM

5. Generation Integrated Operation System (GIOS)



25 hydropower plants (78 generators 1,333 MW)

- 9 Multipurpose Dams (37 Generators, 1,010 MW)
- 16 Weirs (41 Generators, 51 MW)
- New Renewable Energy (Tide, Wind etc. 272 MW)



Hydropower Plants



Monitoring

Remote Control

Water Management Center



3. Successful Results using K-HIT

Success of Water Resources Management

Flood Damage Mitigation

- (2012) **2.1 billion USD** at Successive 3 Typhoons in September
- (2013) **0.9 billion USD** at Heavy Rainfall Events in July
 - Degradation of Water Level 1.6~6.3m in River by Effective Dam & Weir Operation

Cope with Climate Change

- Overcome the Exceed Design Flood caused by Climate Change.
 - (2011) Seomjin and Buan Dam by Typhoon "MUIFA" in September
 - (2012) Namgang Dam by Typhoon "SANBA" in September

Overcome National Drought & Power Shortage Problems

- Predict Drought and Supply Emergency Water during droughts
- Resolve Power Shortage Problem by Generating Hydro Power (Annual 2.9 Billion kwh)

Water Quality

- Supply 860 million m³ for Water Quality Improvement
 - Phenol Leakage in 1991, 2008 and 2009
 - Algal Bloom in 2011, 2012 and 2013

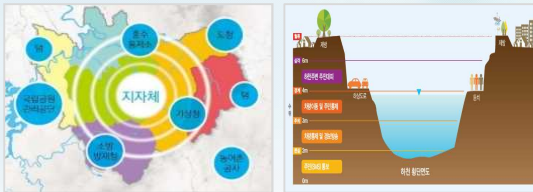
4. Application Cases



Domestic

- Water disaster management for flood prone area (local government)

* Upper basin & tributary



Field Survey

Alternative Review
(Feasibility Study)

Project
Decision

Project
Implementation

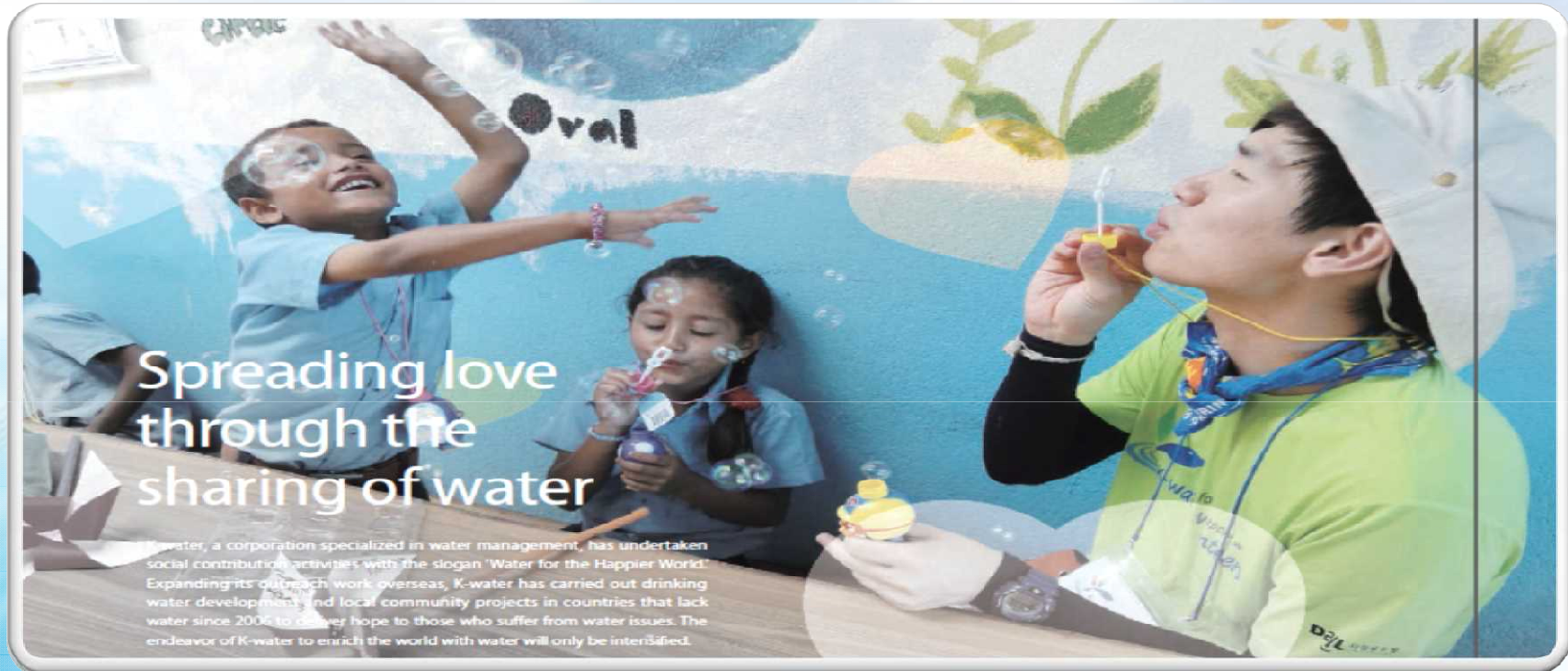
Education
& Handover

Overseas

- Water management project in Asia, Africa, South America, Eastern Europe...



Water for the Happier World



K-water, World leader in Water Management Services

SMART K-water START Together

Thank you for your attention.

The Best Water Partner



K-water Overview

State-owned Water Resources Management Corporation



- **Head Office**
(4 divisions, 24 departments)
- **8 Regional Headquarters**
(28 offices)
- **Total employees : 4,500**

Total Water Service Provider



**Water
Resources
Development**



**Water Supply
& Sewage
System**



**Green Energy
Generation**



**Water Front
City
Construction**

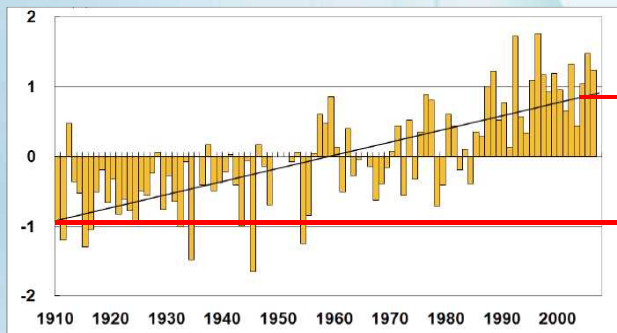


**Research &
Development**

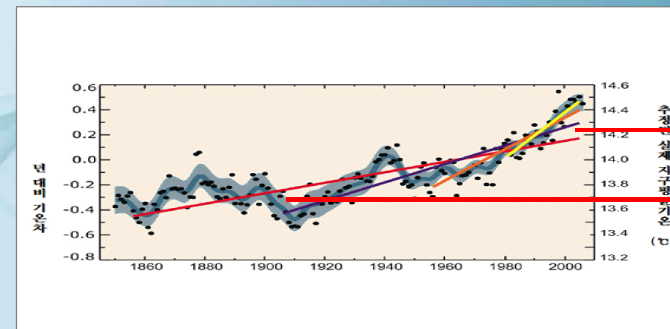
Climate Change Effect

■ Backward (1912~2008)

- Global warming effect in Korea is faster than global average



[Korea Temperature Change]

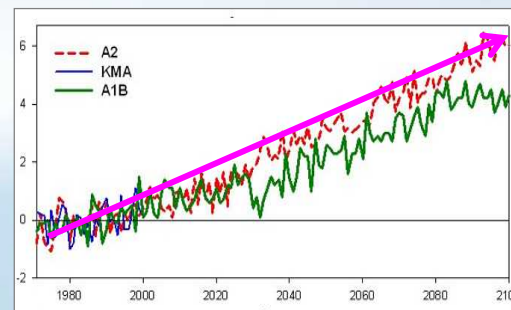


[Global Temperature Change]

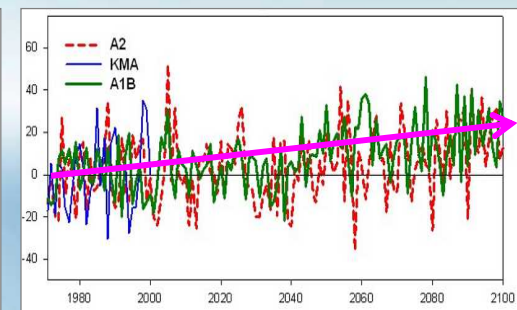
■ Forward (2071~2100)

- Temperature 5.3 °C ↑
- Annual Precipitation 19% ↑
- Rainfall & typhoon intensity ↑
- Extreme weather (Flood & Drought)

Temperature prospect



Rainfall prospect



Energy of Korea



Thermal Energy : 61%



Nuclear Energy : 24%



Hydro Energy : 7%



Renewable Energy : 4%



smart
KPX KOREA POWER EXCHANGE

Water Use of Korea



**Total
Water
Use**

=

33.3 Billion m³/yr

26% of Total Water Resources



River Water

32%

10.8 Billion m³/yr



Dam Water

57%

18.8 Billion m³/yr



Ground Water

11%

3.7 Billion m³/yr

Cope with Climate Change

Flood Control Capacity Enhancement

Sub-Spillway Construction



Imha Dam

Soyanggang, Daechung, Andong, Imha, Juam, etc

Parapet Wall Construction



Milyang Dam

Boryeong, Milyang, Buan, etc

Spillway Structural Change



Gwangdong Dam

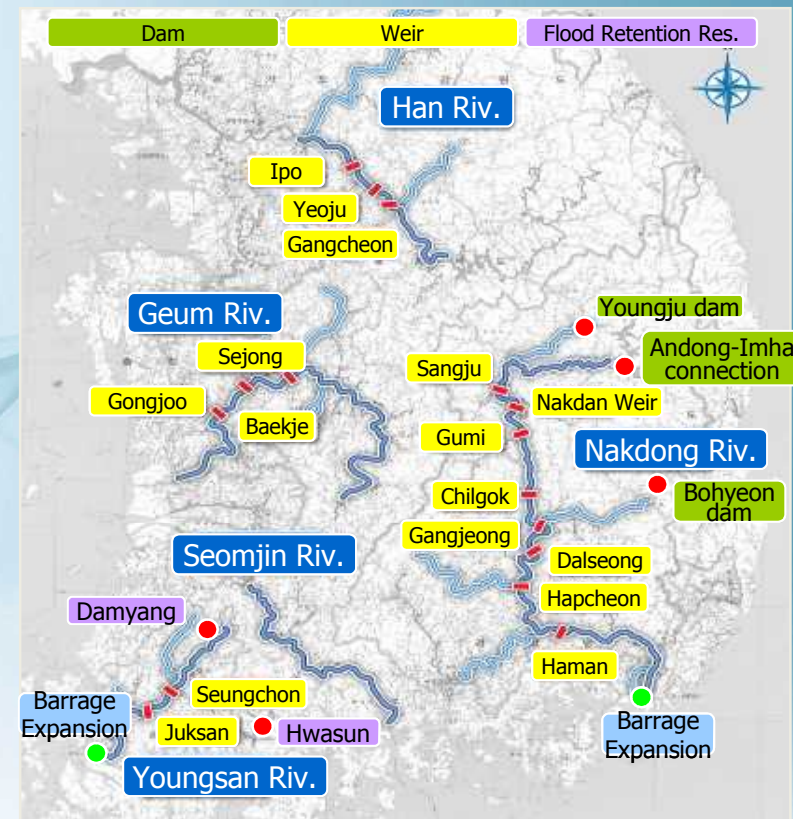
Gwangdong, Dalbang, Yeoncho, Guchun, etc

24 out of 33 Dams require flood control capability improvements to mitigate extreme flooding events caused by climate change

Cope with Climate Change

Project Summary

- **Project period : 2009~2012**
- **Budget : 20 billion USD**
- **Contents**
 - Dredging : 450 million m³
 - Multi-purpose Weir : 16
 - Bank Reinforcement : 620 km
 - Dam : 3 / Eco-stream : 929 km
 - Small Hydro-power Plant: 16
 - Bike path : 1,592km



Flood Damage Mitigation



Drop down river water level (1~6m)

Drought Damage Mitigation



No drought damage after project around 4 rivers

River w/ Nature & Human



Smart water management center

Visitors of the center

- **(Total)** Recent 3years, Annually 3,087 people visit this center
- **(Important Visitor)**
 - 2014 : Minister of Uganda, Minister of China, World bank WGP
 - 2013 : Vice chairman of Congress of Hungary, Ambassador of Pakistan, Chairman of Congress of Thailand
 - 2012 : Delegation of Prime Minister of Thailand, Minister of Myanmar, Ambassador of Nepal, Minister of Water Resources Dep. Of Algeria

