

**1<sup>st</sup> Thematic Workshop on Water Quality at the 4<sup>th</sup> NARBO General Meeting,  
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# **Basin Water Quality Mgt. - IWRM Perspective**

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# Why River Basin approach?

- A **River Basin** is a natural hydrologic operational unit for water resources planning & management
- **Focusing on the river basin** provides a holistic point of view
- Can be used to explore basin-wide water management options

# First Impressions to Korea?

- **Korean War** (June 1950 – July 1953)
- **Han River**
  - ☞ Symbolic meaning of rapid economic growth
  - ☞ GDP per capita: 70-80 US\$ ('60) -> 20,000 US\$ (2000)
  - ☞ **Miracle of the Han River???**
- **Cheonggyecheon**
  - ☞ Value of amenity flow in Mega City  
(Seoul Metropolitan)

# Multipurpose River Basin Development Planning in Korea (Stage 1)

- **Project Name: Han River Basin Reconnaissance level water resources study (HRBR)**
  - **Period: 1966 - 1971**
  - **Prepared by Korean Ministry of Construction, Korea Water Resources Development Corporation in collaboration with US Bureau of Recl./Geological Survey**
  - **Proposed Basin Dev. Plan with 6 storage projects and one barrage to meet the basin water demand by 2012**
-  **Establishing ‘Comprehensive 4 Major River Basin Development Plan’ (’71-’81)**

# Han River Improvement Project (Stage 2)

- **Objective:** Comprehensive and multipurpose development and utilization of the Lower Han River
- **Period:** Sept. 1982 – Sept. 1986 (1<sup>st</sup> Phase)
- **Components:**
  - Channel Improvement for Flood Control
  - Water Quality Enhancement thru. WWT
  - Provision of River-front for Recreation & Leisure
  - Expanding Transportation Network

# Features of Korean Water Mgt. Model

- **Comprehensive Water Resources Planning at the National/ River Basin Levels**
    - ☞ ‘Comprehensive 4 Major River Basin Development Plan’ (’71-’81) based on long-term in-depth basin studies
    - ☞ Long-term National Water Planning (’81-2001)
  - **Gov.-led Intensive investment & mgt. on Water Infrastructures**
    - ☞ Drinking Water Service rate: 17% (’60) -> 99% (’11)
  - **Strong Policy for Water Quality Regulation**
    - ☞ Special Law for 4 Major Rivers to implement TMDL (Since ’99 )
    - ☞ Sanitary Service rate: 8% (early ’80) -> 95% (’11)
- > Common Goal/Target of Korean People to overcome Extreme Poverty!!!**

# National Policies for Water Quality

## Water Quality Preservation

### Management Policy for Public Water Body

- Water environment standards
- Water quality preservation for 4 major rivers
- Water quality preservation for reservoirs
- Source water protection policy
- Total Maximum Daily Load (TMDL) Policy
- Riverine environment management
- Water quality preservation for Groundwater
- Integrated Water Management Measures
- Water environment policy support system

### Policies for Management of Pollutant Source

- Residential sewage management
- Industrial wastewater management
- Livestock wastewater management
- Non-point source management
- Expansion of environmental treatment facilities

### Water Pollution Monitoring

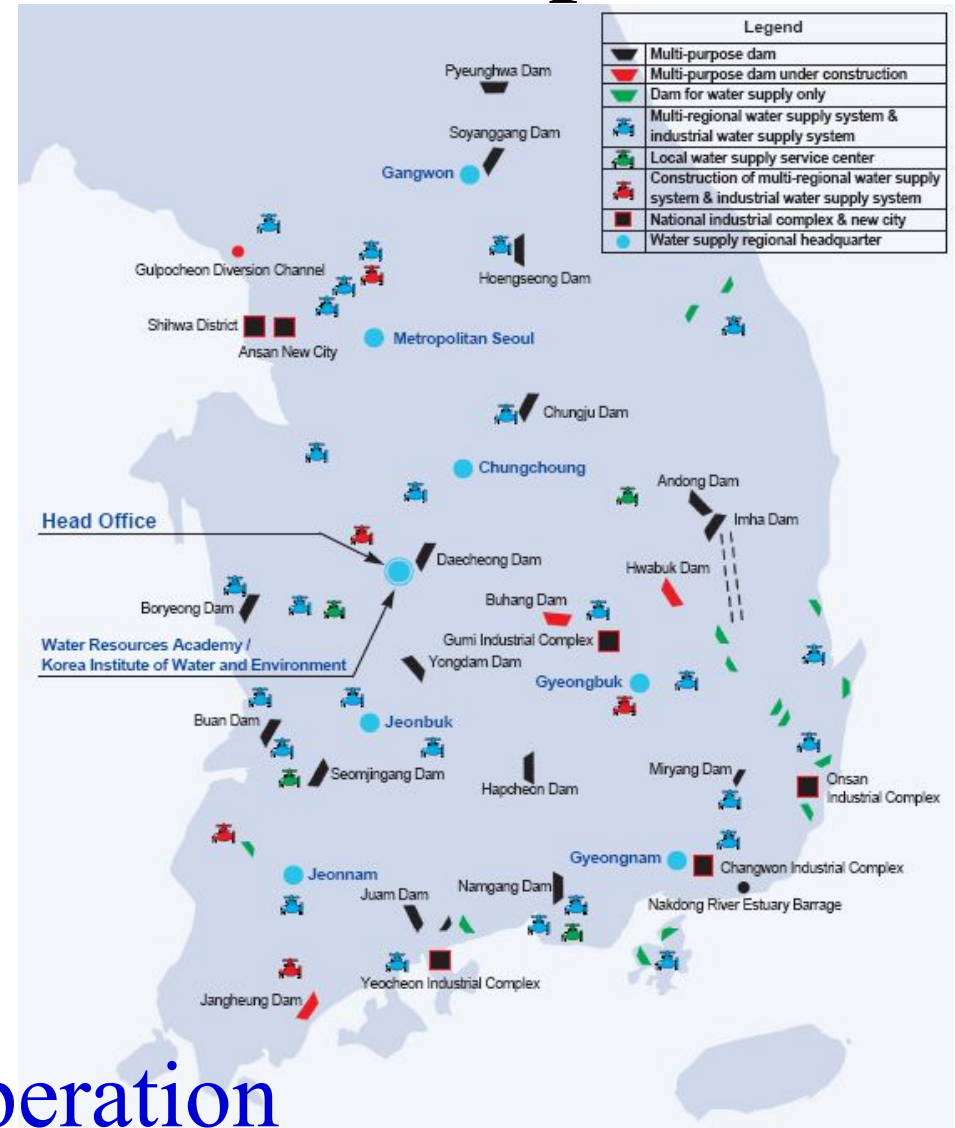
- Water quality monitoring network
- Regulation/guidance
- Water pollution accident
- Development of water pollution process testing methods

# K-water's Environmental Stewardship

- **Operating Facilities**

- 16 Multipurpose Dams  
: 4.4B m<sup>3</sup>/yr
- 28 Water Supply Systems  
: 2.8B m<sup>3</sup>/yr
- Providing 55% of national clean water needs

- **Basin Water Quality Mgt.**  
with Reservoirs System Operation  
to provide quality water!!!





# *Water Quality Monitoring*

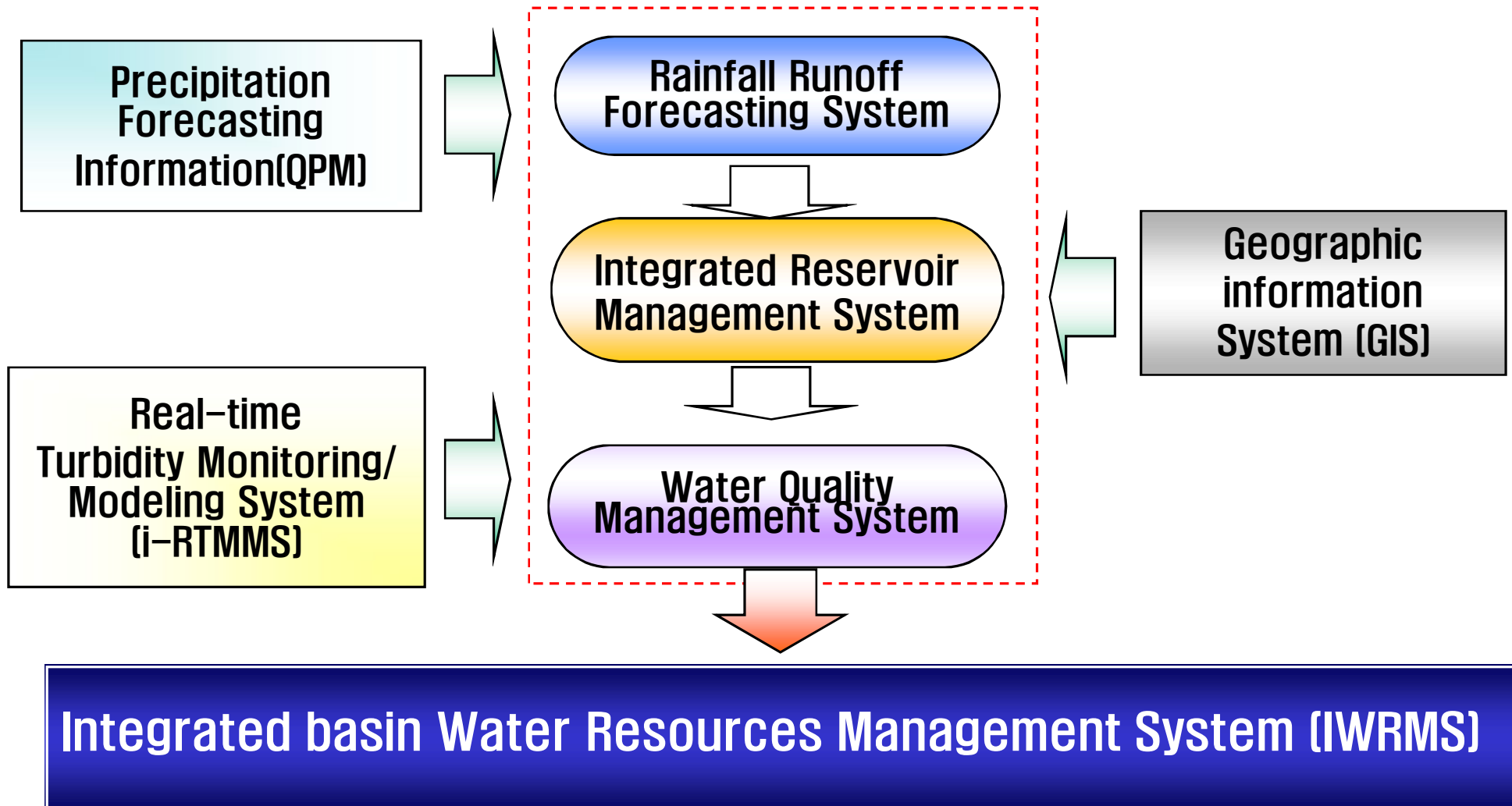
- Monitoring water quality in reservoirs/upstream rivers
- 105 locations (river: 31, reservoir: 74)
- 36 water quality variables COD, BOD, etc.



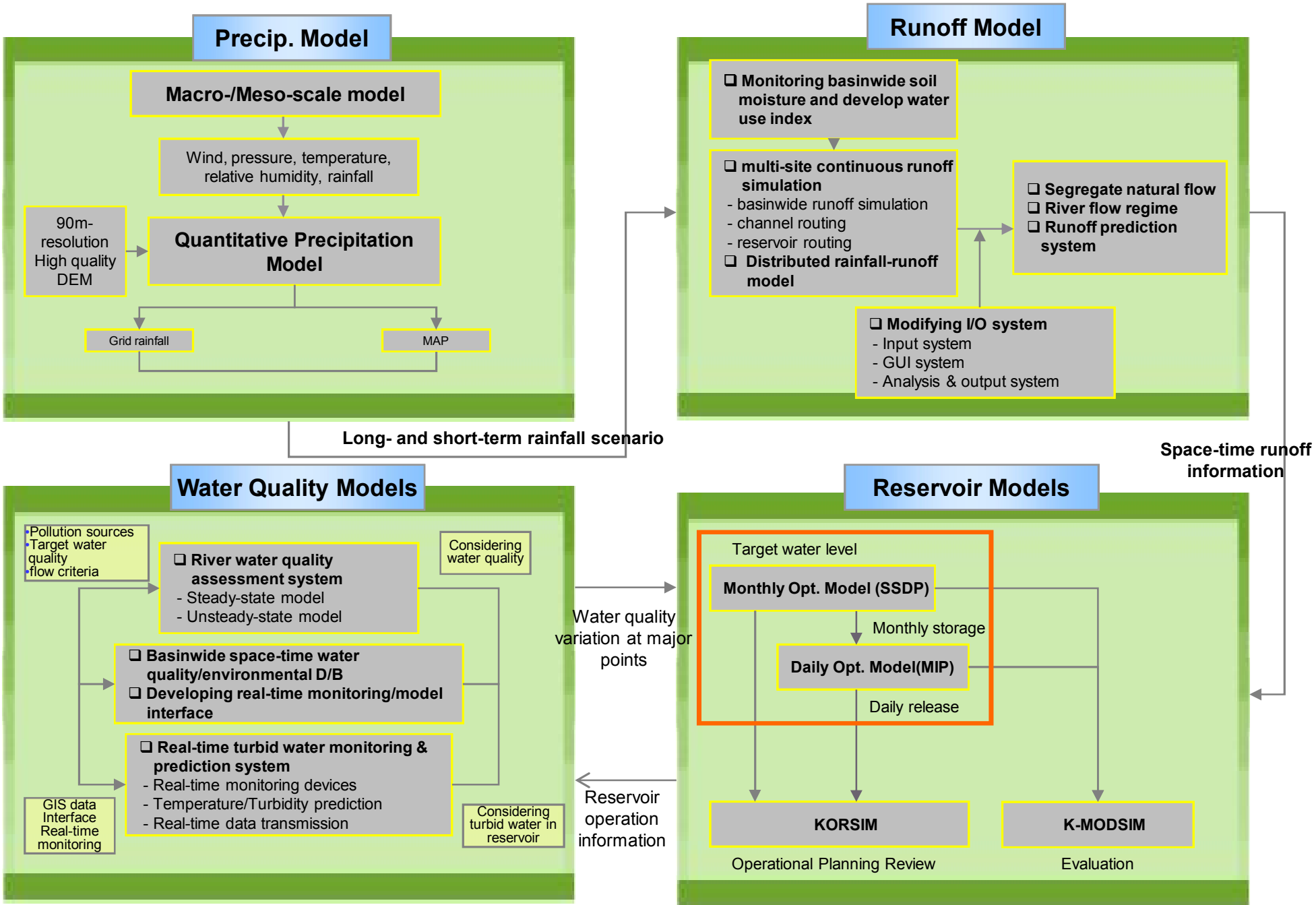
# *Water Quality Management Technology*

- For water quality management
  - Water quality monitoring & modeling in River and Reservoir
  - Reservoir operation considering downstream water quality
  - Basinwide turbid flow assessment with real-time turbidity monitoring system
- IWRM approach
  - basin water mgt. toolkit (DSS) for integrated water quantity & quality mgt.

# Toolkit for Integrated Basin Water Mgt.



# IWRMS DSS



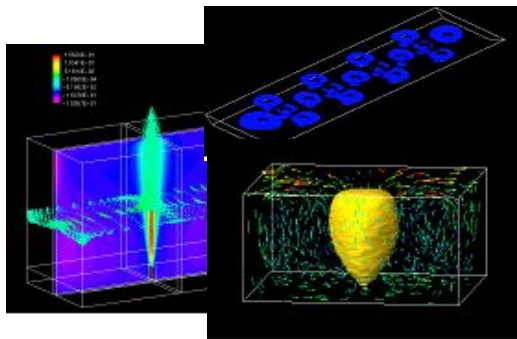
# System Application & Validation Results

## Water Quality & Ecology

- Development of River & Reservoir Water Quality Models
- Development of Real-time Watershed Turbidity Monitoring System



▲ Real-time Turbidity Monitoring System



▲ Reaeration Simulation

- Determine Reservoir Release considering D/S Water Quality Prediction
- Simulate Turbidity Inflow Process and Decision Support to Reservoir System Operation
- Optimal Artificial Aeration Design and Operation to improve Reservoir Water Quality

- GIS Based Decision Support System

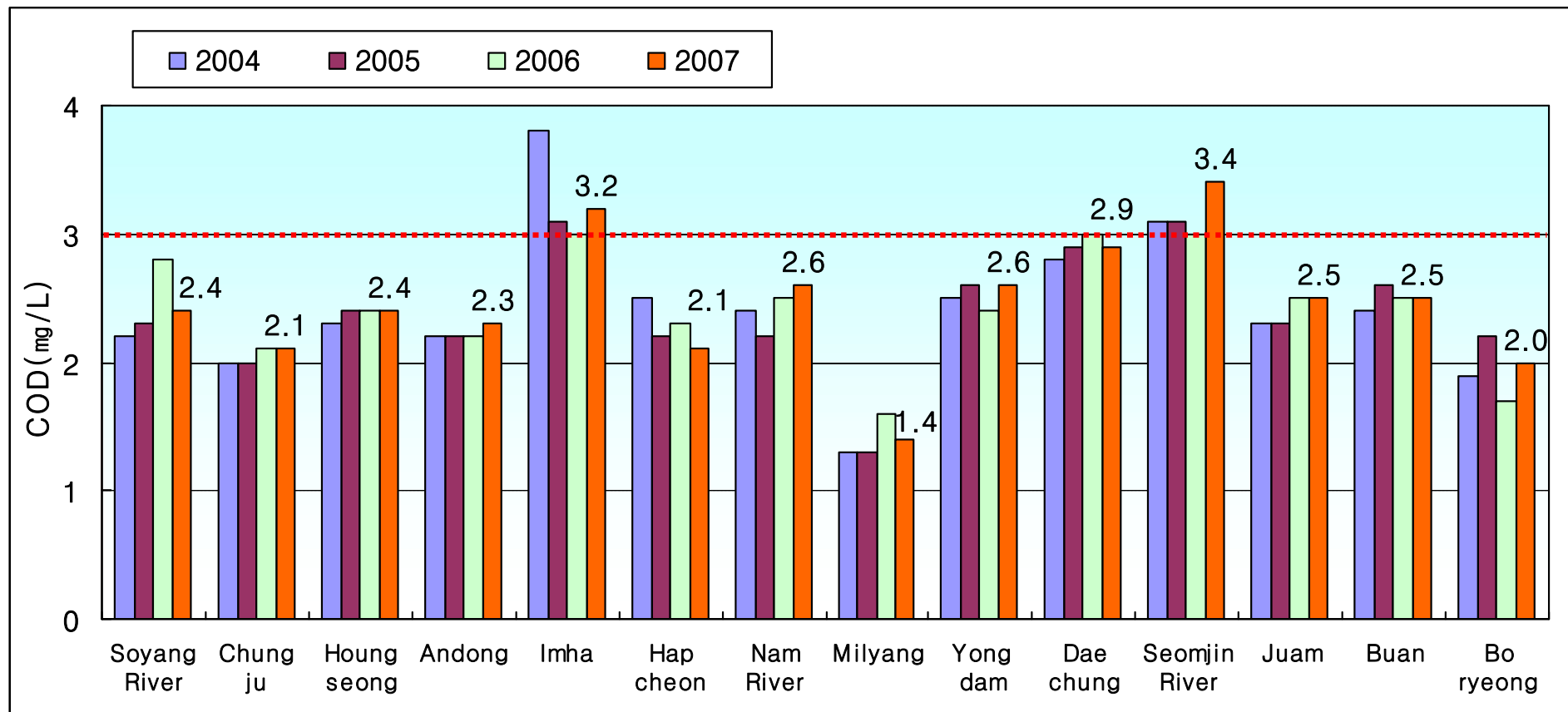


▲ IWRMS GUI

# Water Quality Conditions in Multipurpose Reservoirs

Overall good

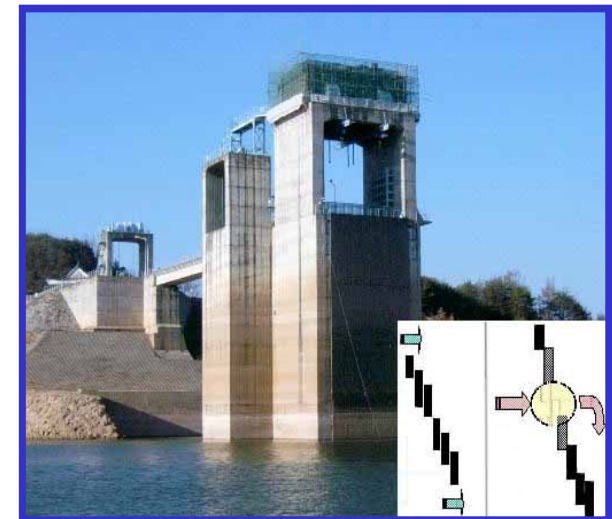
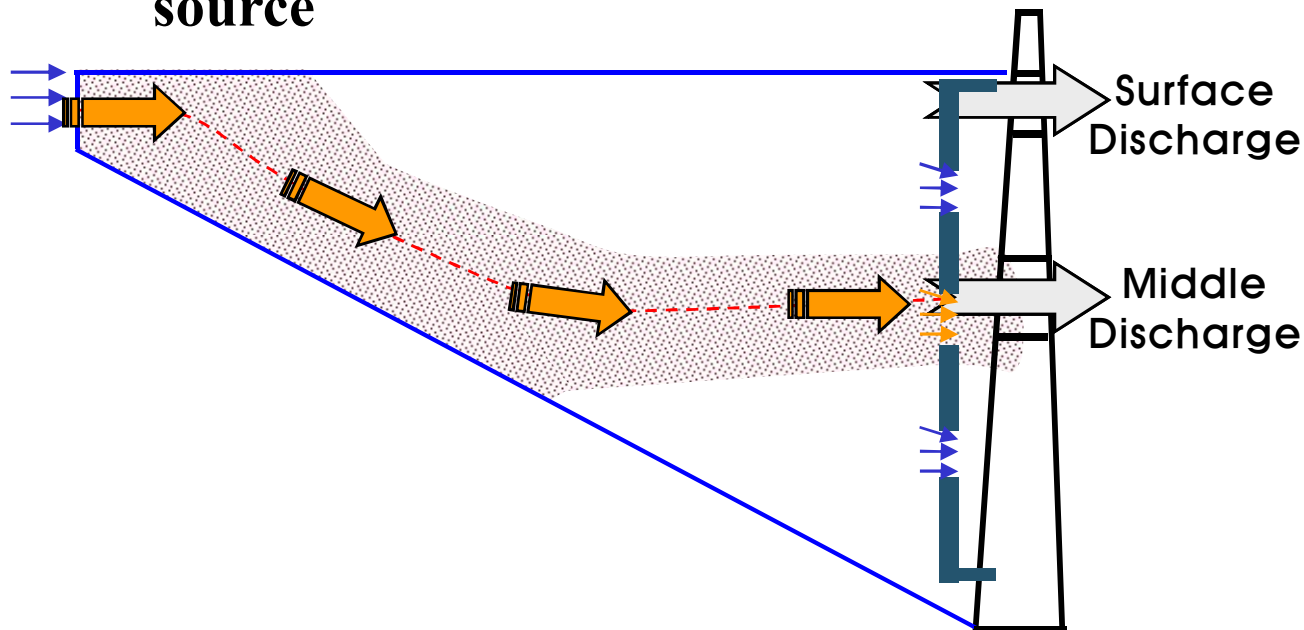
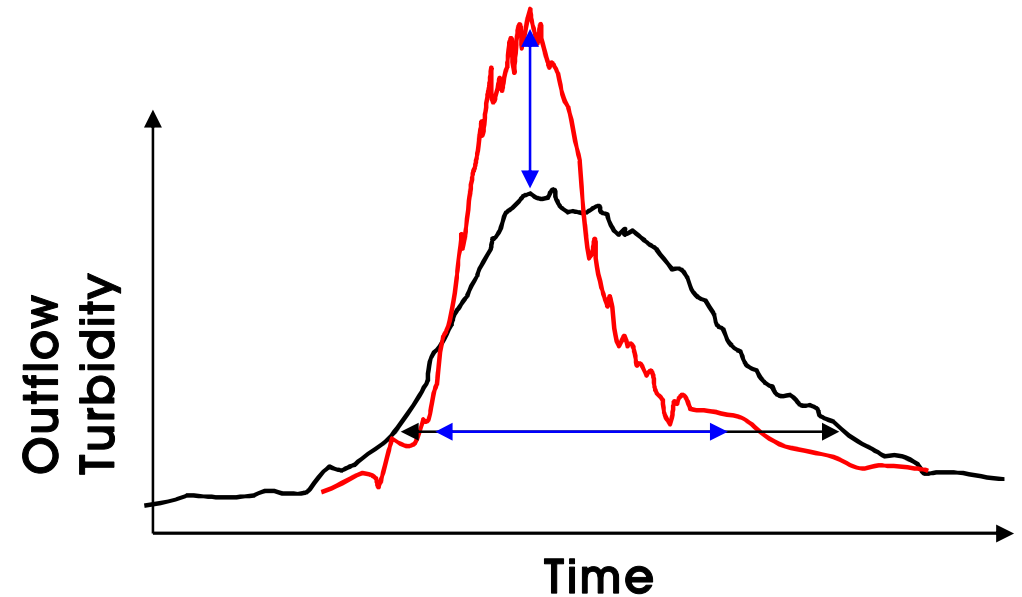
Temporal water quality problems during summer due to turbid water and algal blooming



# Key Concepts for Effective Water Quality Management

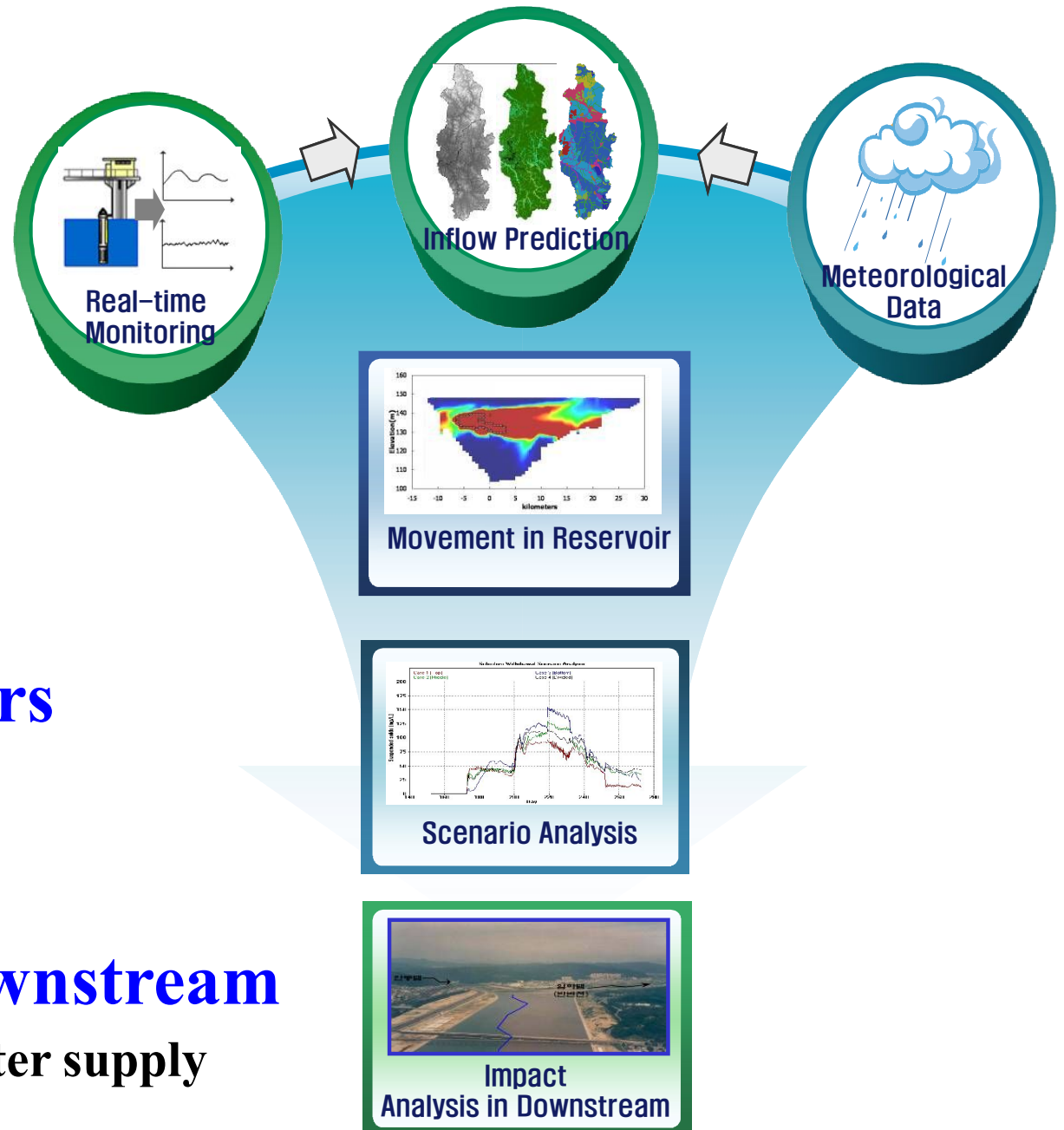
- **Key Concepts & Objectives**

- Maximize removal of polluted water quickly
- Minimize the impacts of water pollution in the reservoir and d/s river reach
- Maximize high quality water source



# Example of Water Quality Management System

- **Real-time monitoring**
  - Temperature
  - Water Quality Parameters
- **Turbid water inflow prediction**
  - Flow
  - Water Quality Parameters
- **Movement in reservoirs**
  - Travel time
  - Distribution of Pollutants
- **Impact analysis in downstream**
  - Impact on downstream water supply

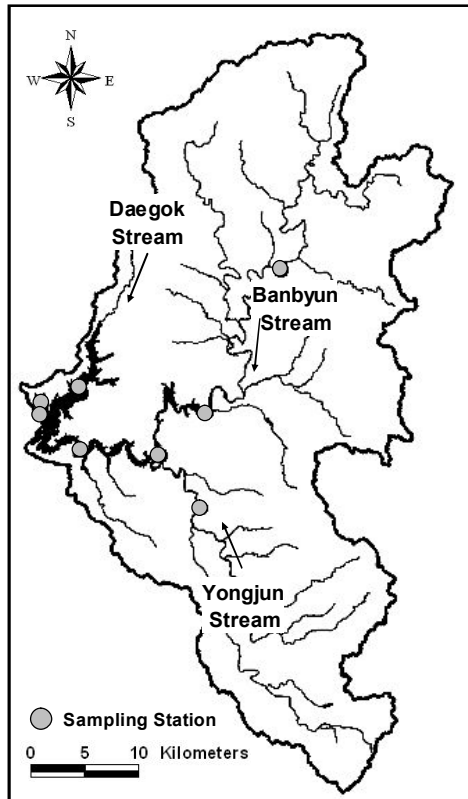


**System Structure**

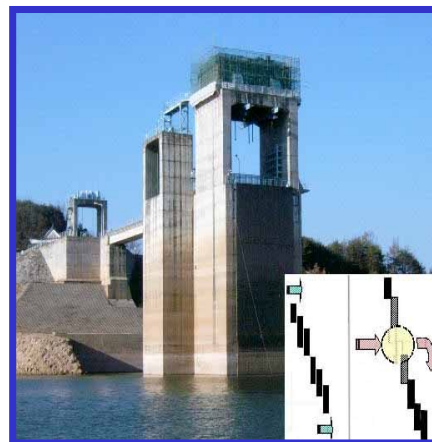


# System for Imha-Angong Watershed

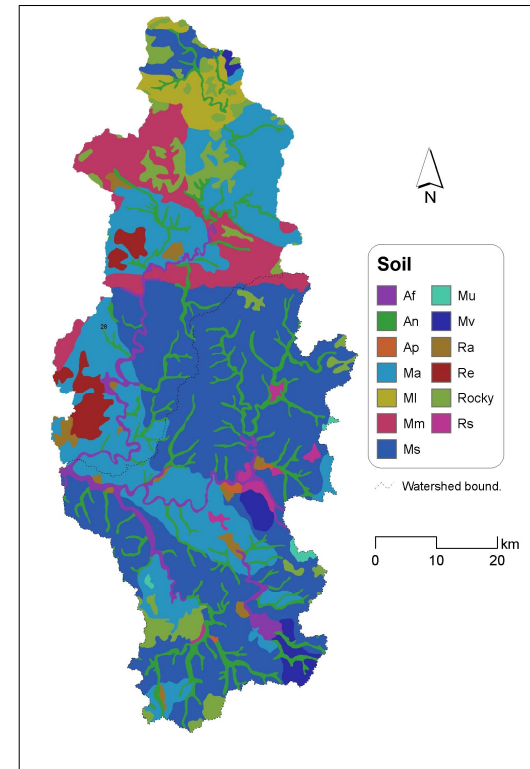
- **Monitoring systems were installed at 9 sites**
- **SWAT, HSPF, CEQUAL-W2 Models were constructed and calibrated**
- **Selective withdrawal facility was implemented**



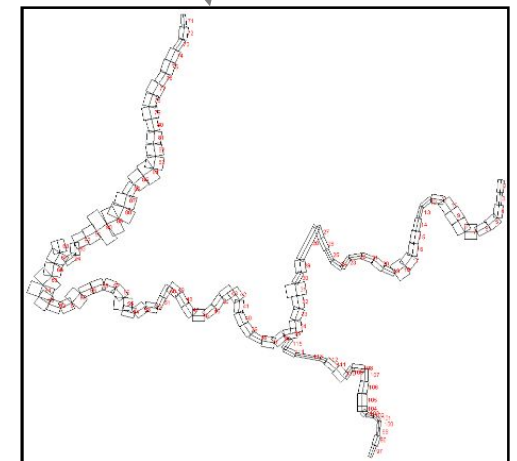
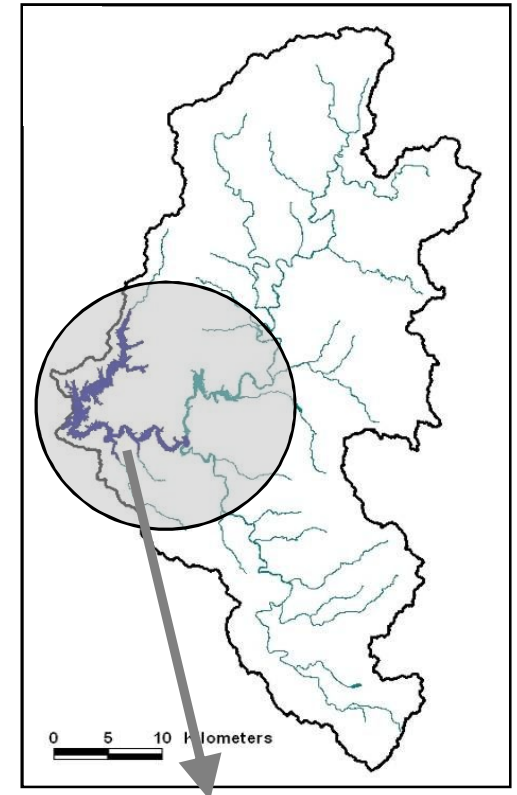
**Monitoring System and Field Measurement**



**Selective Withdrawal Facility**



**Watershed Model**



**2-D Reservoir Model**

# *Future Directions* for Water Quality Management

Predictive, Preventive Water Quality Management

## Paradigm Shift Required

### IWRM Approach

- Upstream watershed
- Reservoir
- downstream

### Preventive Management

- WQM in Reservoirs is not effective
- Pollution source control is required

### NPS Control

- NPS: 20~50%
- Effective NPS control is required

# International Collaboration with **NARBO**(Network of Asian River Basin Org.)

- December 2004  
Signed MOU with **Indonesian NARBO**  
for Collaboration
- March 2005  
Conducted ***Twinning Program***  
between K-water and PJTI & PJTII
  - To compare river basin management practices
  - To share technology and Information



# International Collaboration

## *NARBO 3<sup>rd</sup> Training Workshop*

- November 2005

Hosted 5-day NARBO 3<sup>rd</sup> Training Workshop with ADB

- 25 trainees from RBOs of NARBO member countries
- Topic: **“Technology for IWRM”**
- Shared experiences among Asian countries
- Built international collaborative relationships on IWRM

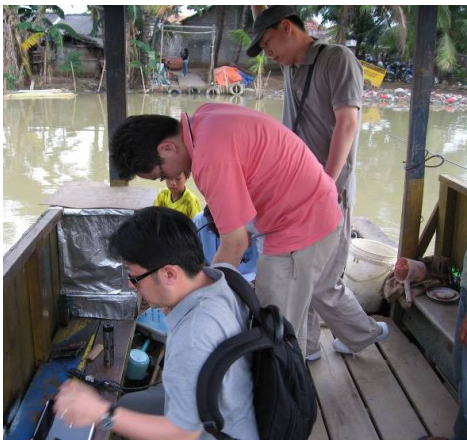
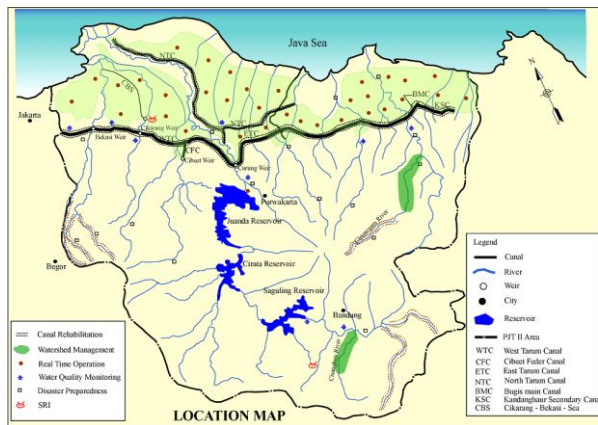


# International Collaboration

## **ADB PDA Project** (Dec.2006 – Dec. 2007)

Conducted ADB Pilot Demonstration Activity Project (PDA)

- NARBO and GOI strongly recommended this PDA to ADB
- **K-water & PJT II** conducted this PDA together
- Developed a **Water Quality Management System for the West Tarum Canal of Citarum River Basin**



# Launching K-water Hub

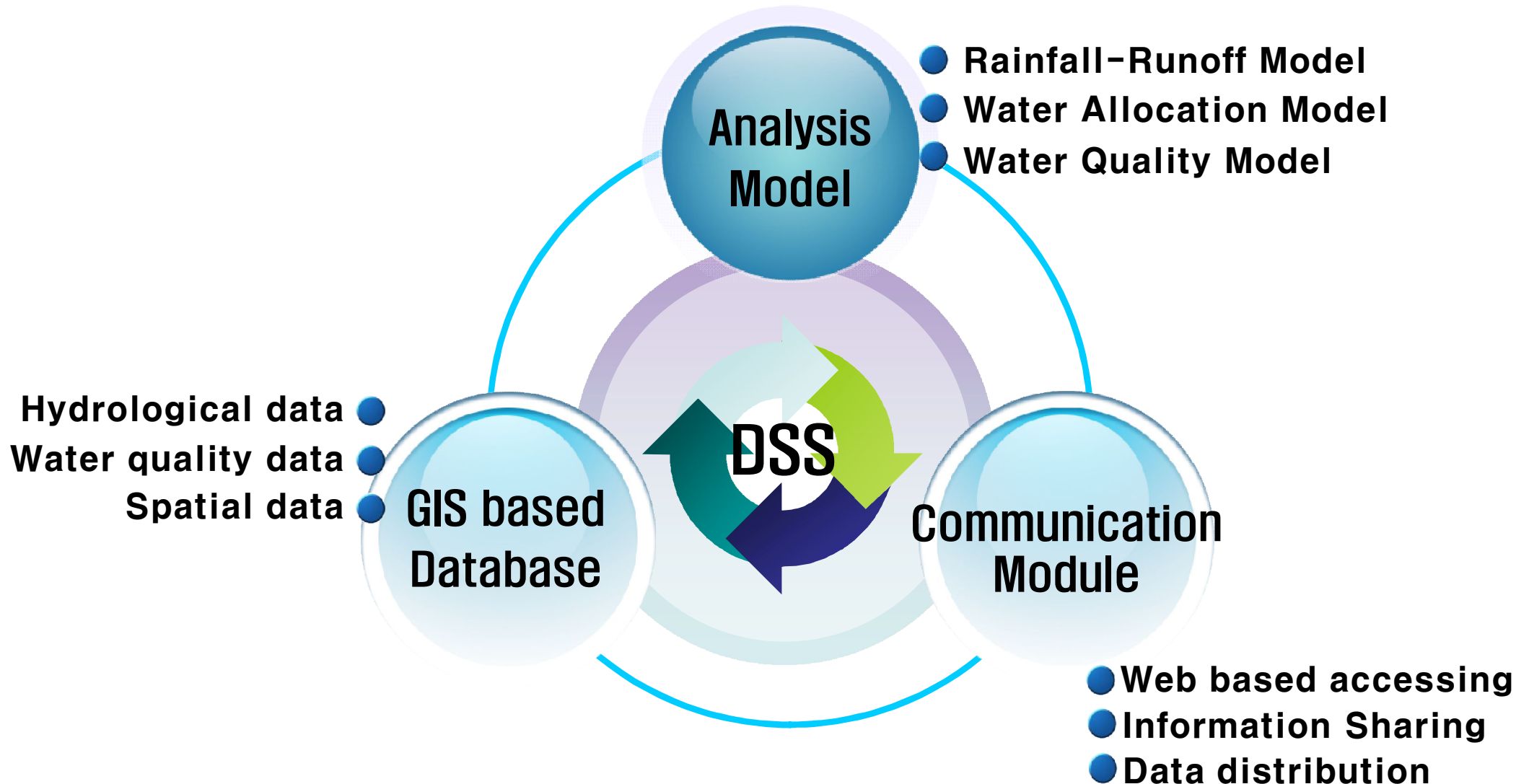
## Signing of LOI for Citarum Project (August 2009)

- Launched K-water Hub as APWF's regional water knowledge hub on water quality management in river basins
- Signed Letter of Intent (LOI) for *Citarum Project*

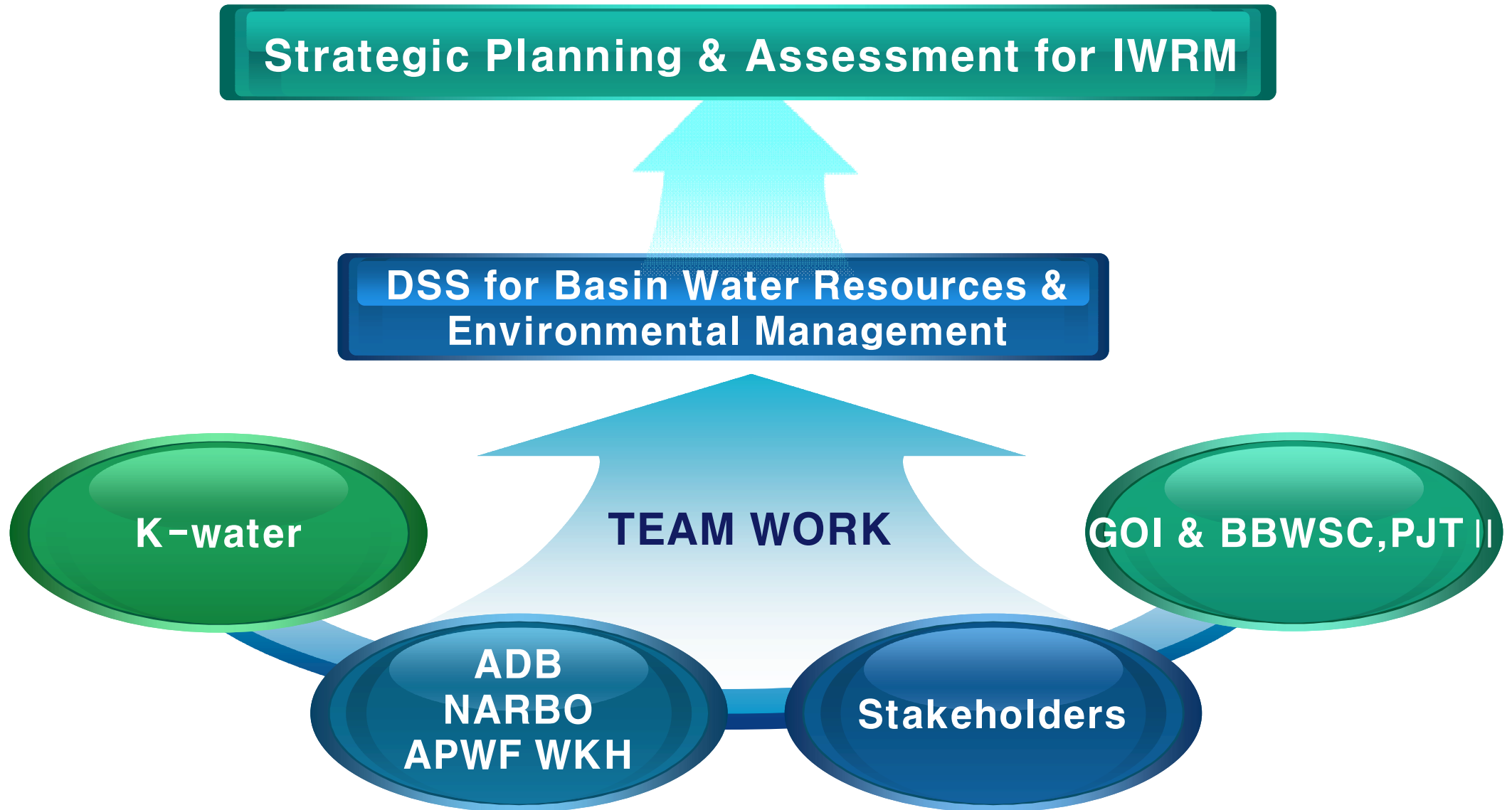


# DSS (Decision Support System)

## DSS Module & Component



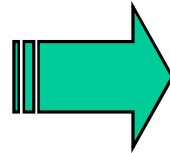
# Network for Citarum Collaboration






# Changing Paradigm and the Needs for IWRM

- **Water resources for economic growth**
- **Construction of water supply facilities**
- **Water treatment facility expansion**
- **Simple engineering problem**
- **Government-led management**



- **Water for Sustainable Development & Management**
- **Water Supply and Demand Management**
- **Considering Basin Water Quality, Environment and Ecology**
- **Multi-sectoral problem (social, econo., & env.)**
- **Participation of interested parties(Consensus)**


 **Water Vision 2020 (2001); demand mgt, efficient water use, comprehensive flood mgt. & water quality mgt. at the river basin level**

# Green Growth in Asia Pacific Region

- New Approach to **sustainable economic growth** in Asia
  - Emerging Concept which stems from the idea that **environmental services in water management** could and should play a greater role in triggering **economic growth** and in progressively decoupling economic growth from environmental degradation
- > Environment from the view point of Growth?

# Conclusion;

- **Basin water quality management in 21C must be addressed thru. a collaborative, integrated, & holistic process of IWRM!**
- ***Key Success Factors:* How to promote Integrated Basin Water Resources Development and Management?**

 **by redressing the past imbalances of IWRM concept among economic, environmental, and social components???**

 **by incorporating the Green Growth Concept into IWRM approach?**

**⇒ common challenge for sustainable dev.!!!**

**⇒ Think Regional, Act Local, & Share Regional/Global!!!**

# *Thank You*

