Integrated Water-Supply Management Systems

- Water Supply Systems in Korea
- Integrated Water-Supply Management System (IWMS)
- Model Implementation for IWMS

Jae-Heung Yoon, Ph.D.

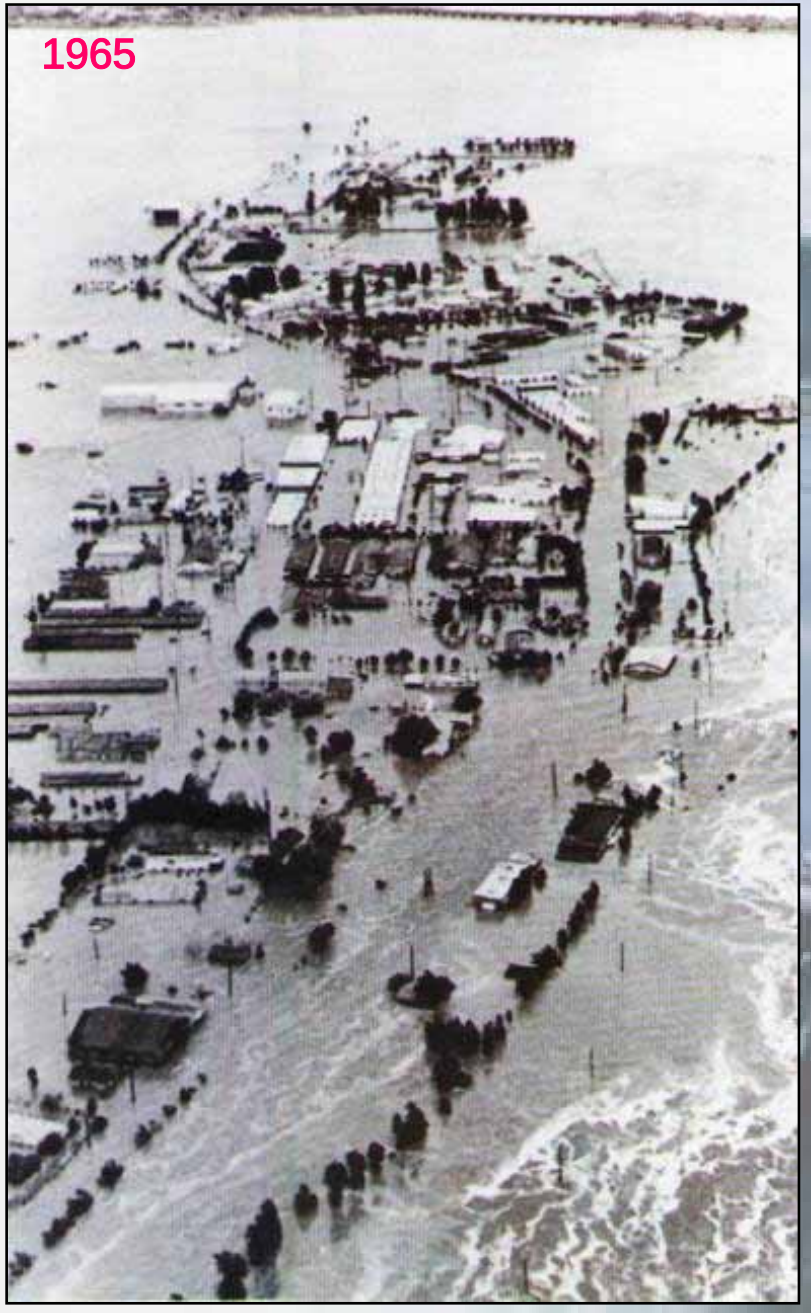
Korea Water Resources Corporation

Water Supply Systems in Korea

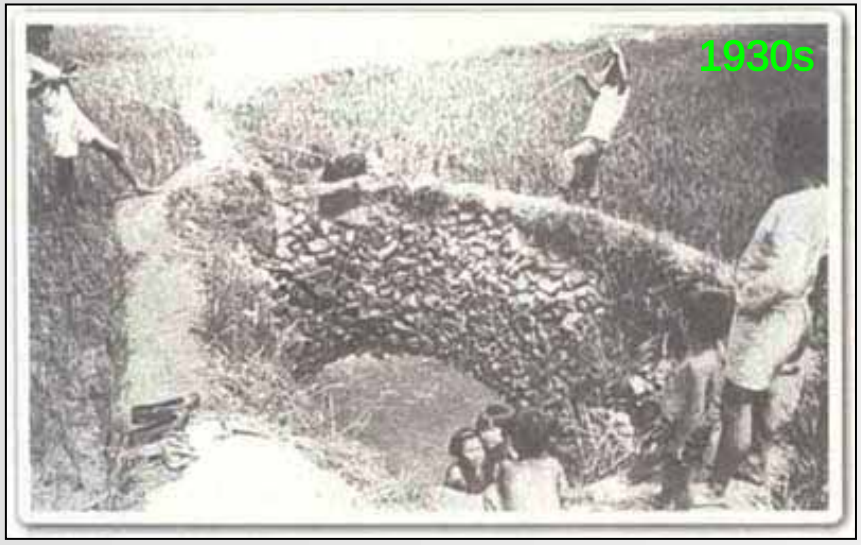
Characteristics of Water Resources

- Precipitation
  - Average precipitation: 1,283 mm/year (1.3 times the world average)
    - Water per capita: 2,705 m^3 (12% of the world average)
  - Two thirds of annual precipitation during wet season (June – Sept.)
  - Water shortage during dry season (Oct. – May)
- Topology
  - Steep land slopes from the East to the South
  - Large coefficient of river regime
  - Geology: Granite (weak groundwater aquifers)
- Results
  - Frequent floods, droughts and water shortages (in the past)

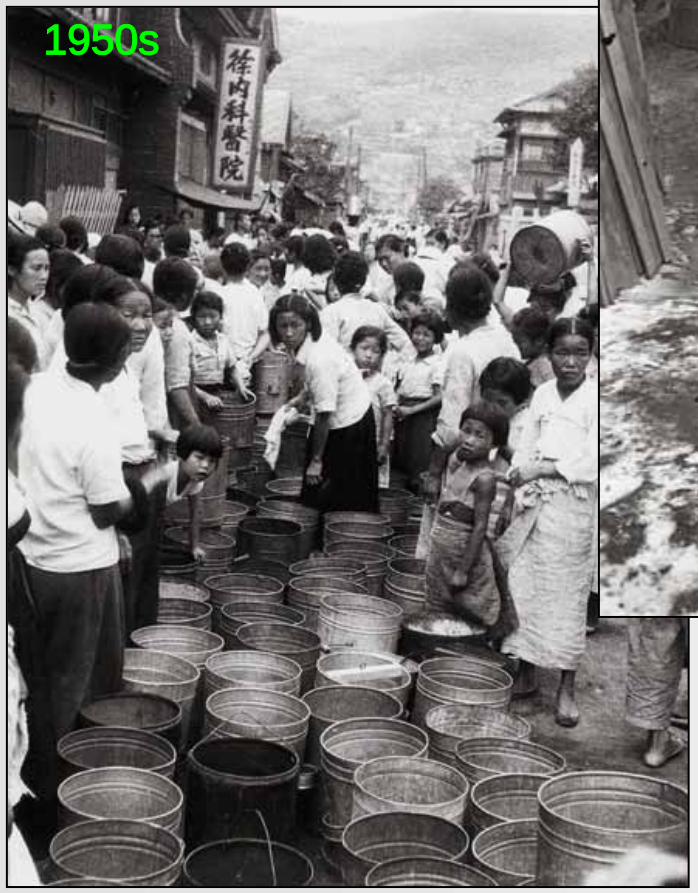
Floods in the Past



Water Supply in the Past




1960s


1950s
徐內科醫院


1970s

National Policies for Solution

- Construction of Multi-Purpose Dams
  - Flood control during wet season
  - Water supply during dry season

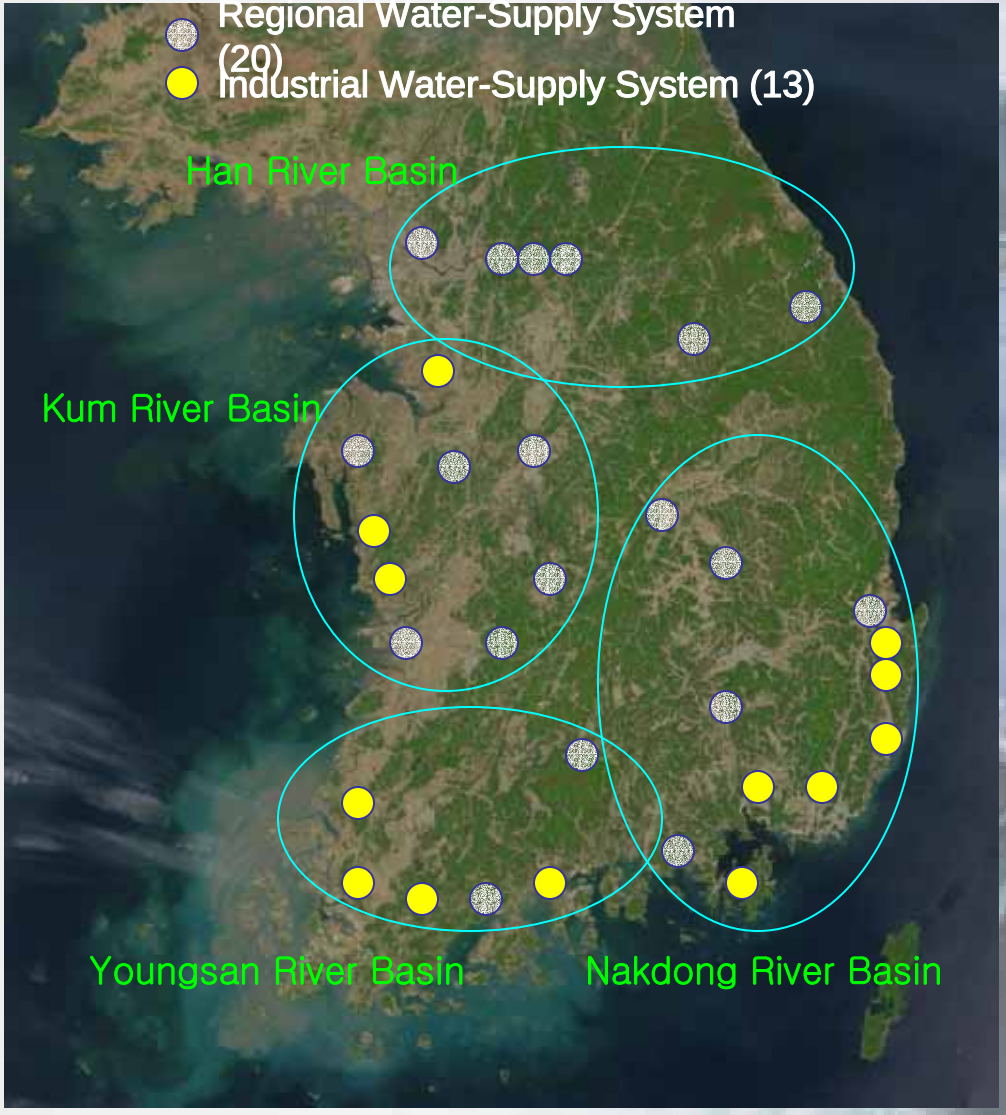
    (domestic, industrial, agricultural, river maintenance)
  - Hydropower generation
- Construction of Regional Water-Supply Systems
  - Water supply to local governments
  - Large scale pipeline systems

    (conveyance and transmission lines)
  - Large scale water treatment plants

    (source water from the multipurpose dams)

Construction of Multi-Purpose Dams

Regional Water-Supply Systems



Catchment Water-Quality Management

- Comprehensive River-Basin Management (1988 – 2002)
  - Four major river basins (Han, Kum, Nakdong and Youngsan)
  - Master plan for "Water Quality Management of Source Water" (established for each river basin)
  - Enactment of laws associated with source-water quality improvement
  - Principle of water-user payment (allotment for water use)
    - ✓Construction and operation of waste water treatment plants
    - ✓Land purchase
    - ✓Projects of water-quality improvement
    - ✓Support for upstream communities
- Source Water Protection
  - Program of Total Maximum Daily Load (TMDL)
  - Establishment of buffer zones

Water-Supply Systems in Korea

- History of Water Supply
  - 1960s - 1970s: Local Water-Supply Systems (LWS)
  - 1980s - 1990s: Regional Water-Supply Systems (RWS)
  - 2000s - : Integrated Regional Water-Supply Systems
- RWS & LWS

System	Definition	Operation & Maintenance	Government Body
RWS (IWS)	Supply to more than one local government	KOWACO	Ministry of Construction and Transportation (MOCT)
LWS	Supply to one local government	Local Governments	Ministry of Environment (MOE)

❑ Regional and Industrial Water-Supply Systems

Operating		Constructing		Planning (2011)		Total	
RWS	IWS	RWS	IWS	RWS	IWS	RWS	IWS
20 (11.1)	13 (3.8)	11 (4.2)	5 (0.5)	18 (4.4)	9 (2.9)	52 (19.7)	27 (7.3)*

* (Capacity): million m^3/d

❑ Water Treatment Plants (Q > 1,000 m^3/d)

Capacity	Total	LWS		RWS
		Slow Filter	Rapid Filter	
Total	634	182	422	30
< 5,000 m^3/d	392	159	233	–
- 20,000 m^3/d	98	20	76	2
- 100,000 m^3/d	87	3	77	7
> 100,000 m^3/d	57	–	36	21

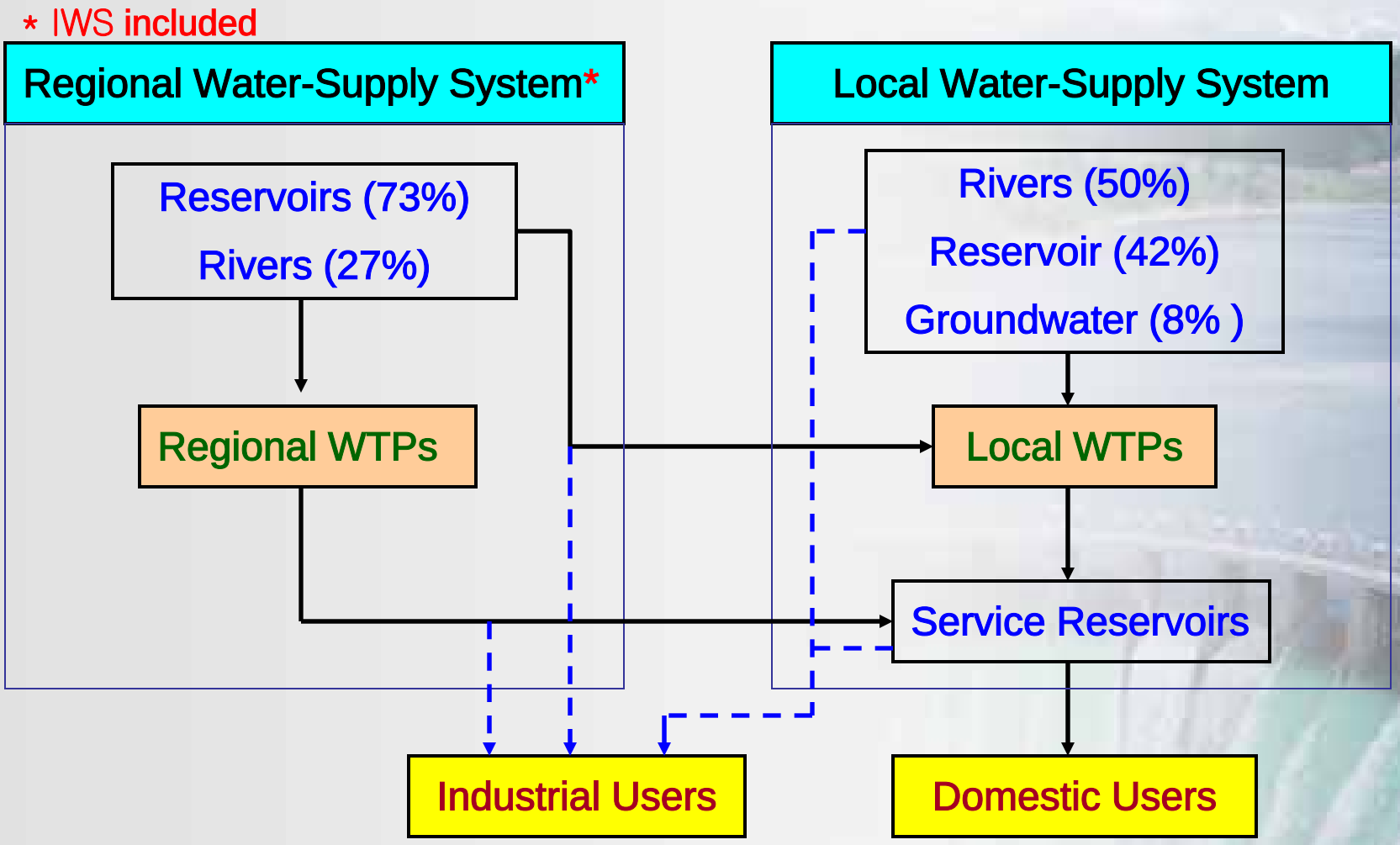
* Number of small systems: 24,474

❑ Trend in Water-Supply Status

	1992	1995	1998	2002	2011
Population (million)	44.6	46.0	47.2	48.5	49.8
Coverage* (%)	80.2	82.9	85.2	88.7	95.0
Capacity (million m^3/d)	18.7	21.8	25.7	28.6	30.3
Lpcd	385	398	395	362	427

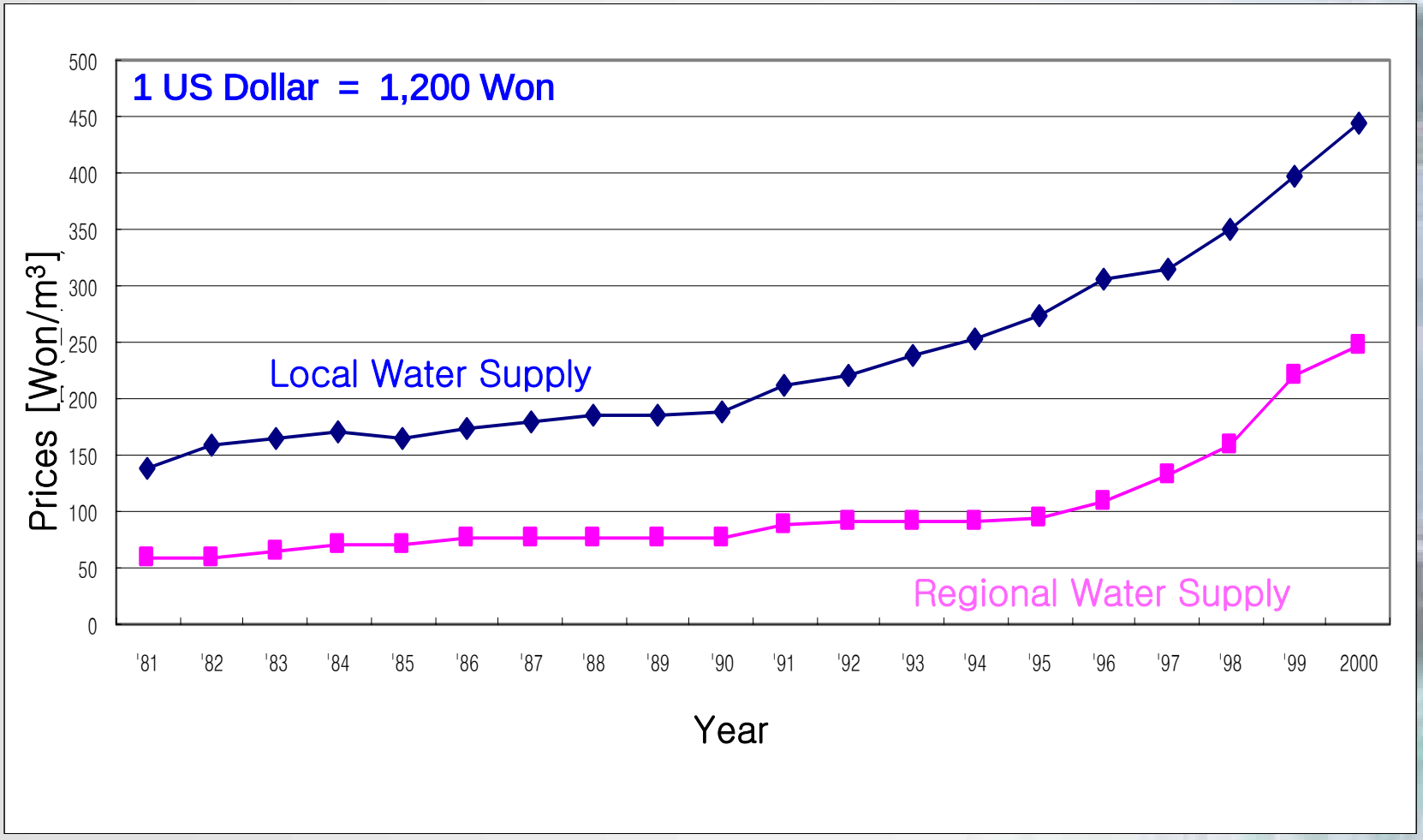
* Metropolis: 98.5 %, Towns: 80.1 %, Small communities: 31.1 %

Structure of Water-Supply Systems



Water Rates

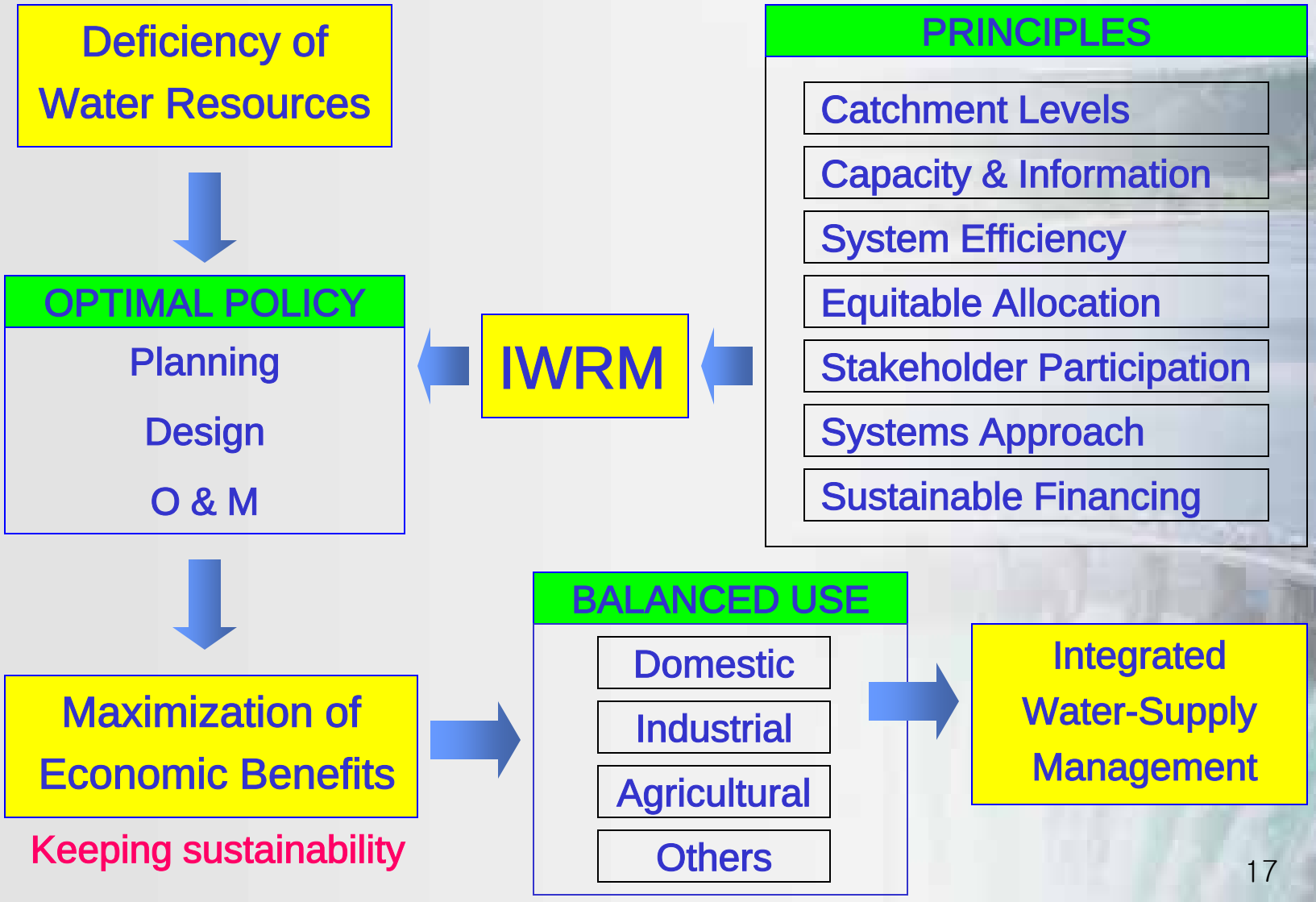
Average Water Rate of LWSs in 2004: 514 Won/m^3



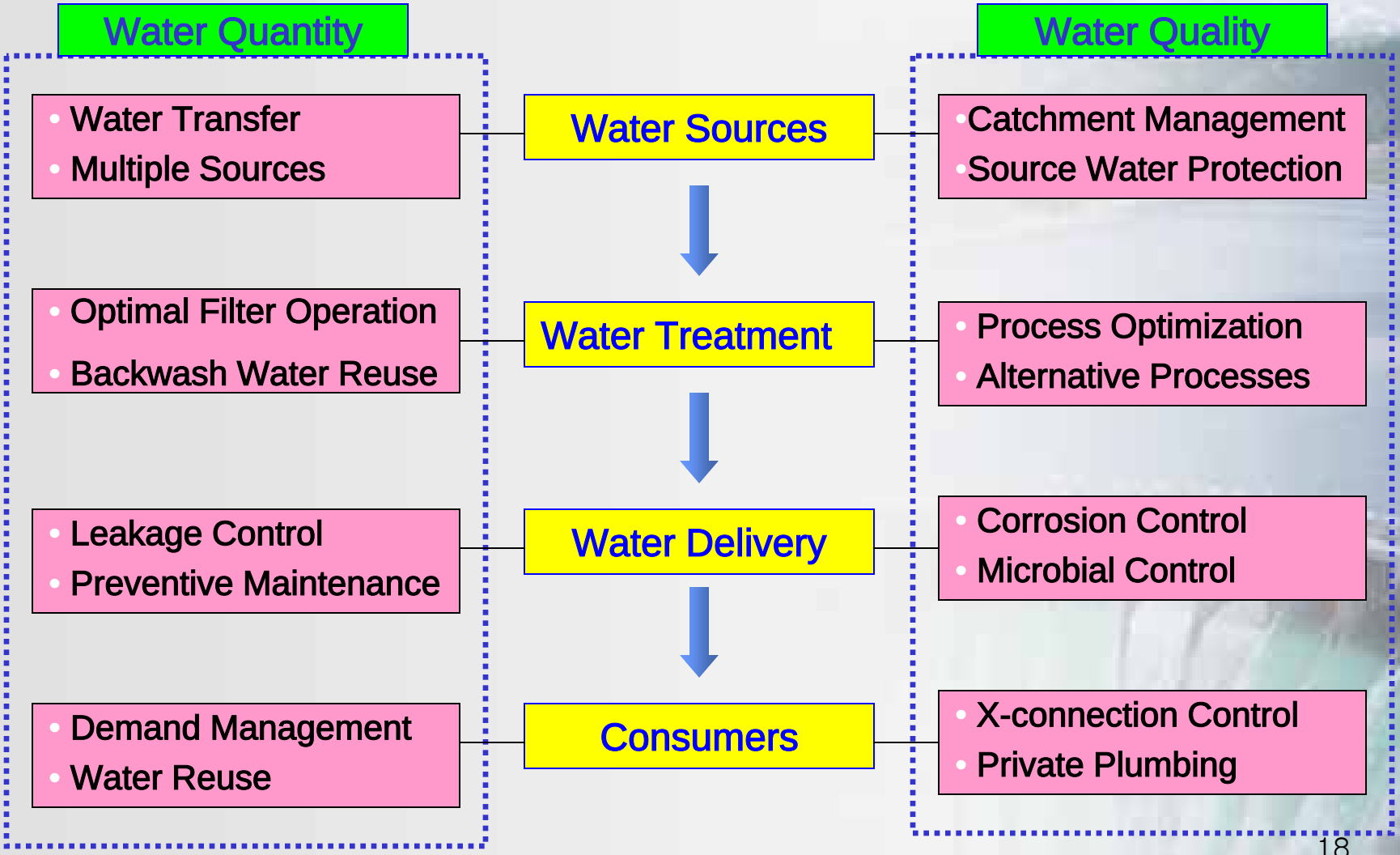
Water Rates in 2004 (Won/m^3): Settled Water: 292, Filtered Water: 357

Integrated Water-Supply Management Systems (IWMS)

Integrated Water Resources Management

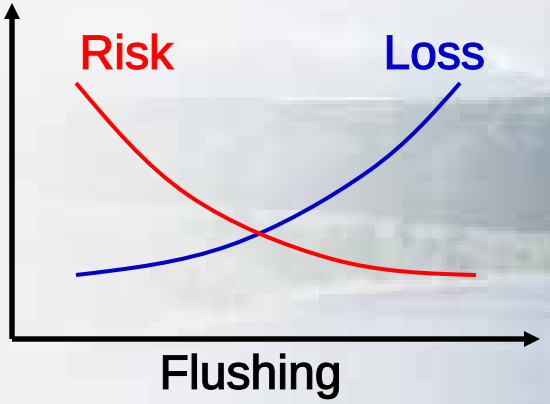


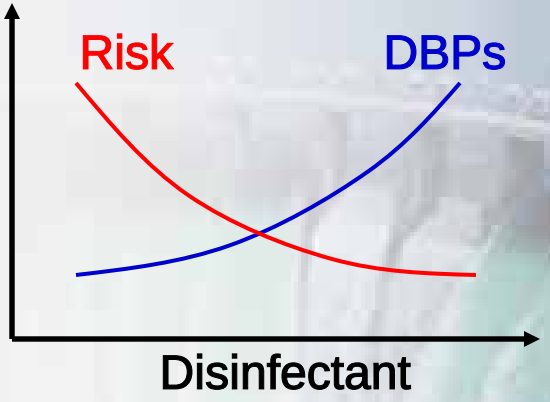
Integrated Water-Supply Management



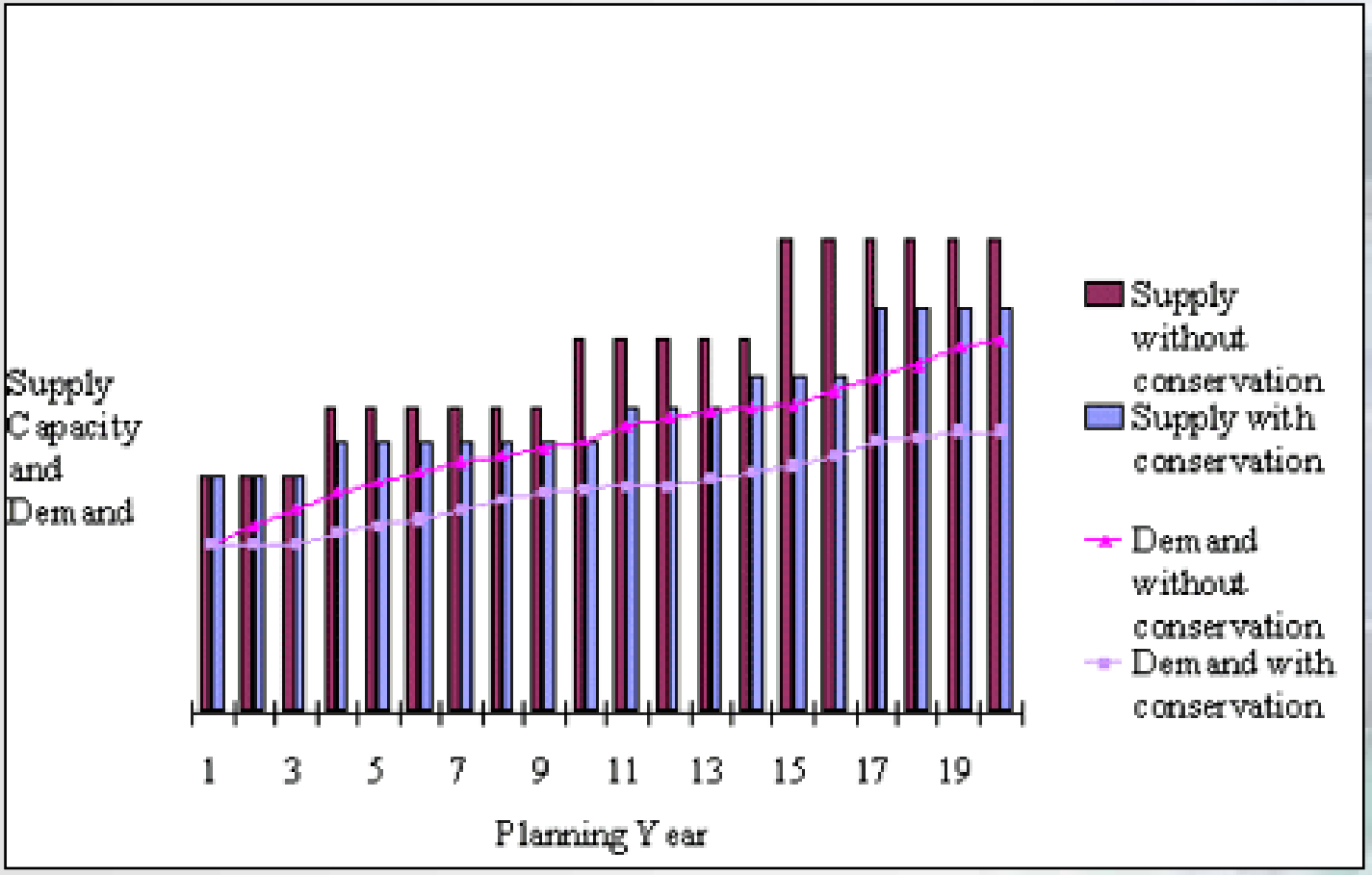
Implication of Policies

- Between Quantity and Quality
  - Flushing program
  - Filter-to-waste
  - Leakage control
- Quality
  - Disinfection by-products (DBPs)
  - Treatment technique requirement
- Quantity
  - Demand management
  - Leakage control





Supply & Demand with Conservation



Problems of Regional Water-Supply Systems

- Single Water Source
  - No responses to droughts, emergencies, and incidents
- Development / Management by Multi-Agencies
  - Duplicated and inefficient investment
- Unbalanced Allocation
  - Water shortage in local areas (Restricted supply to 0.3 mil. persons)
  - No water transfers among the systems (fixed allocation)
- Inefficient Water-Supply Systems
  - Duplicated service areas among the systems
  - Long-distance water delivery

Problems of Local Water-Supply Systems

- Deterioration of Source Water (river water)
- Inefficient Management in Small Systems
  - Only public sectors (without business mind)
  - Number of staff / 1000 m^3 : 2.87 persons (Capacity < 2,000 m^3/d)
    - ✓ 0.12 persons (Q > 300,000 m^3/ d)
- Lack of Qualified Operators
  - Percent of technical experts: 19.8 %
  - Low payment
  - Frequent change of staff's job (67 % within 5 years)
- Week Financial Status
  - Government-driven tariff (Low recovery ratio)
    - ✓ 92.5 % in metropolis, but 80.7 % in others
  - Average debt ratio (debt / own capital): 0.27

Integrated Water-Supply Management System

- Objectives

  To improve the unbalanced water supplies and demands among different water uses and regions by integrated management

- Principles for IWMS Establishment

  - Reliability in Water Quantity and Quality
  - Equity in Water Supply
  - Efficiency and Economy in Operation
    - ✓ Reducing management and operational personnel
    - ✓ Increasing maintenance personnel
  - Optimal Operation of Treatment Process Trains
  - Consumer Satisfaction

Master Plan for IWMS

Phase	Period	Contents
1	1998 - 2000	❑ Regional division (12 Regions) ❑ Revision of associated laws and regulations
2	2001 - 2003	❑ Development of water transfer scheme - Demand forecast and water auditing - Correction of water allocation ❑ Basic design for IWMSs
3	2004 -	❑ Design and construction of IWMSs ❑ Construction of Inter-regional operating systems

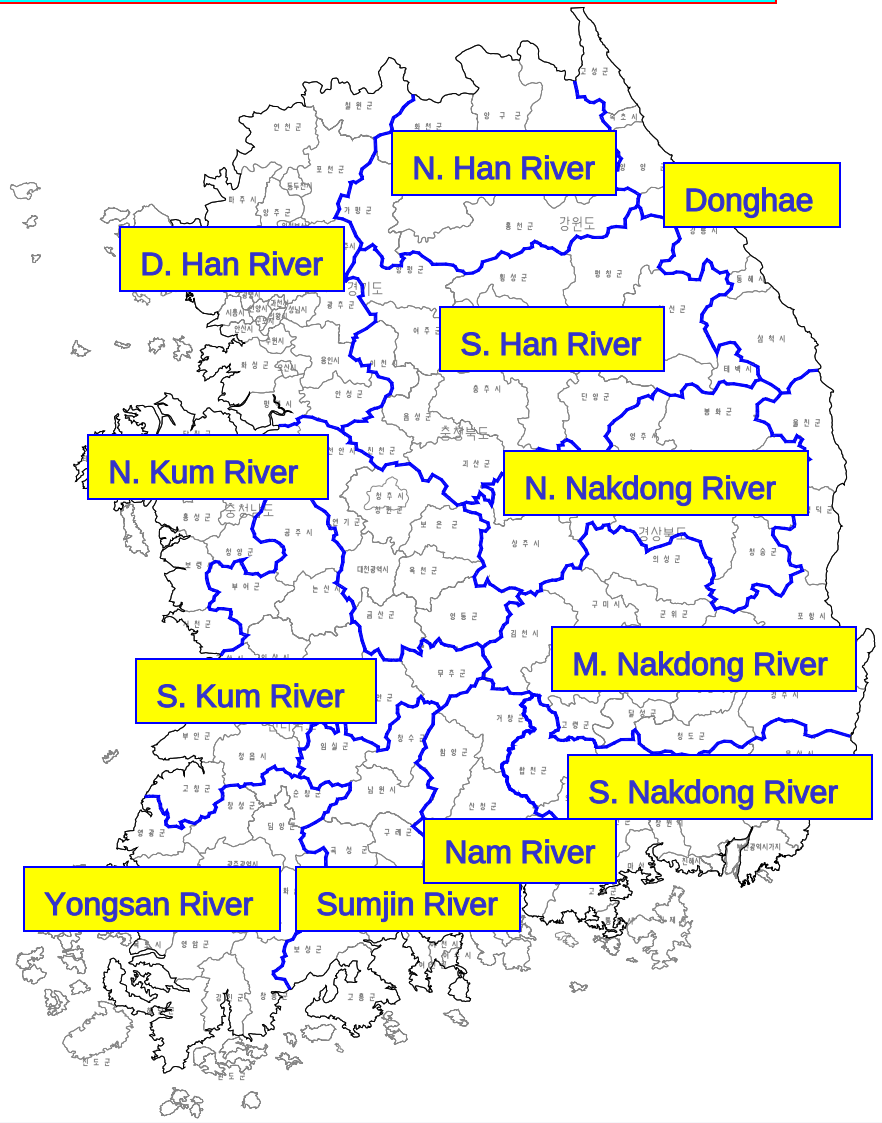
Regional Division for IWMS

Criteria for Division
• Based on river basins • Geographic conditions • Water transfer • Water sources

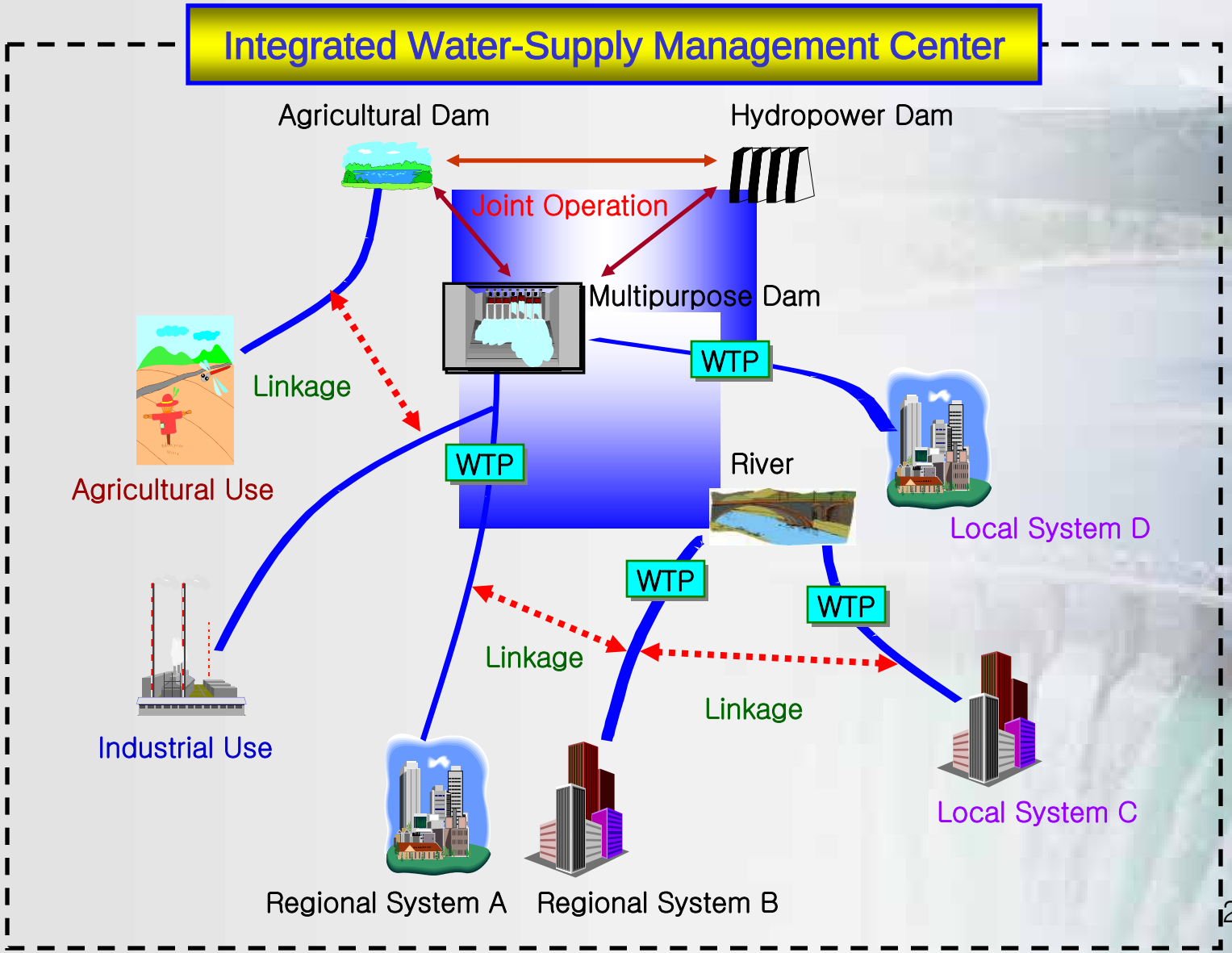
Systems	Number of Systems *
RWS & IWS	75
LWS	140

* Capacity > 10,000 m^3/day

Regions for IWMS



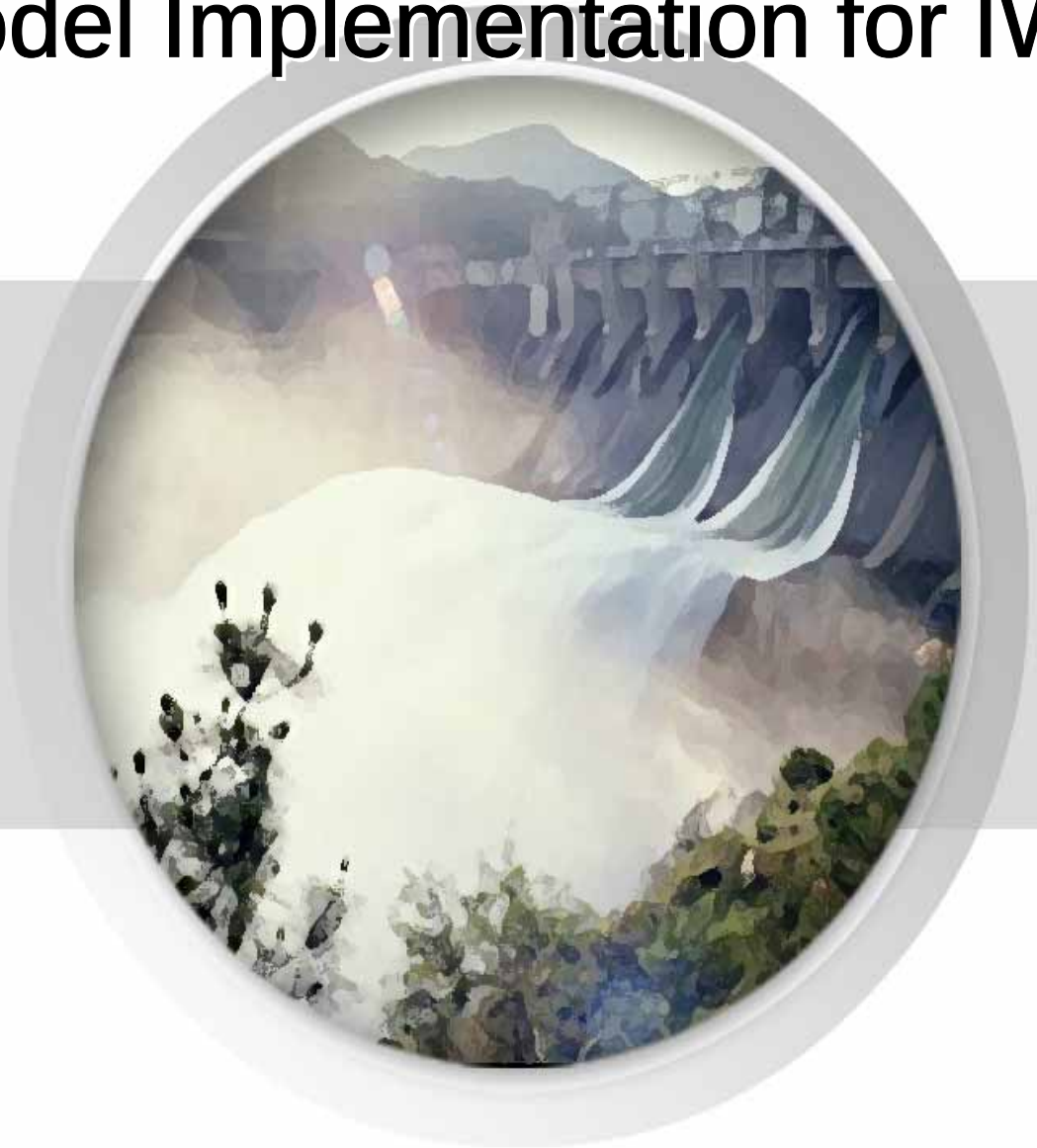
Construction of IWMS



Water Transfer

- To Supply Water to Shortage Areas
  - Asan IWS → Sapkyo AWS (140,000 cmd)
  - Seoul Metropolis RWS → North Kyungki Area (650,000 cmd)
  - Juam Dam → Kwangyang Area (200,000 cmd)
  - Daecheong RWS → Asan IWS → Boryung RWS
- To Eliminate Duplicated Water-Supply Areas
  - Jeonju and Seomjin Rriver RWSs → Jeongeup and Kimje Cities
- To Delay Construction of a Dam
  - South Chungnam RWS (Jicheon Dam Construction) (2006 → 2011)
- To Consider Water Quality
  - Domestic water from Kum river RWS → Industrial use
  - Domestic water from Jeonju RWS → Kum river RWS

Model Implementation for IWMS

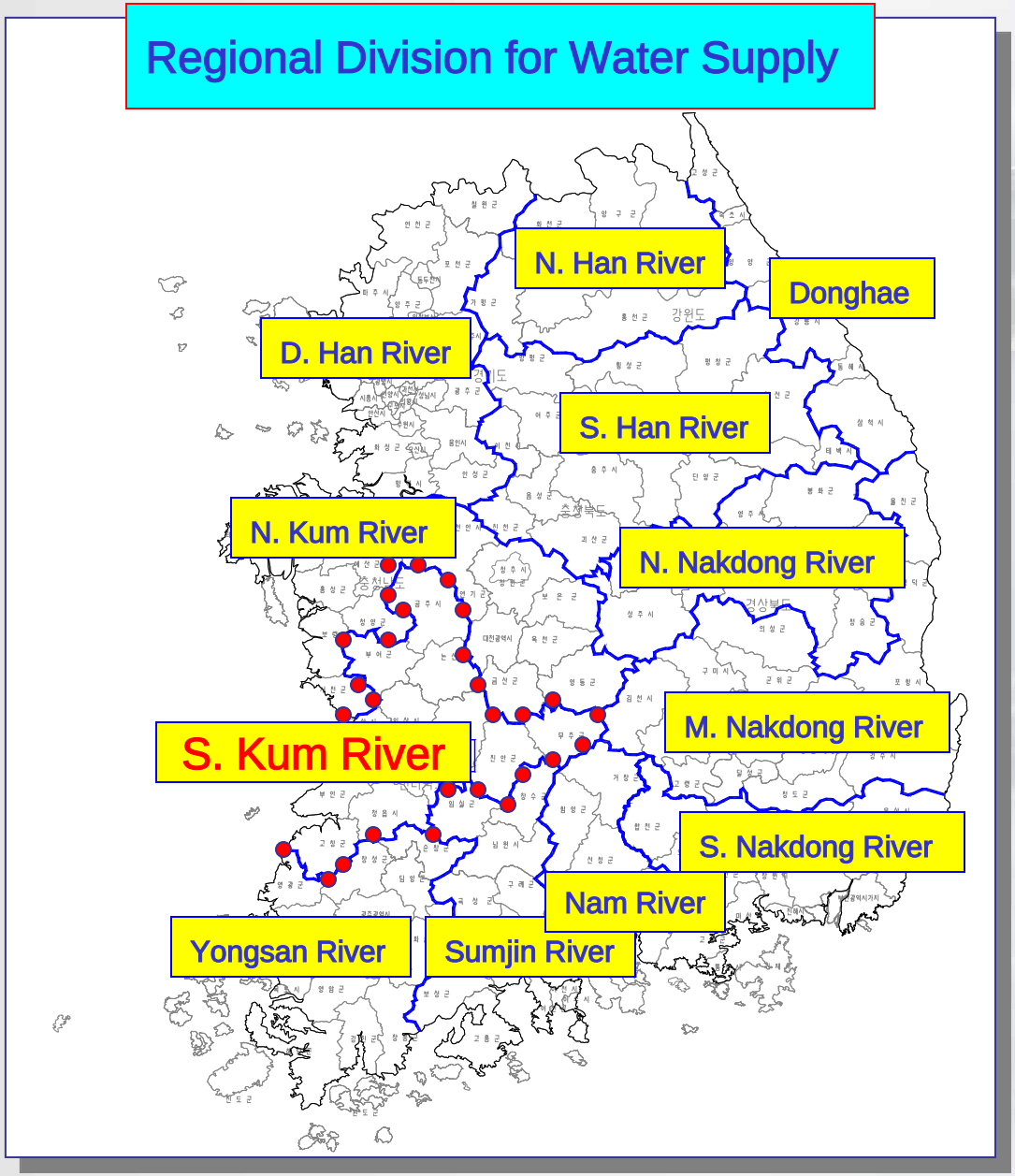


Systems in South Kum-River Region

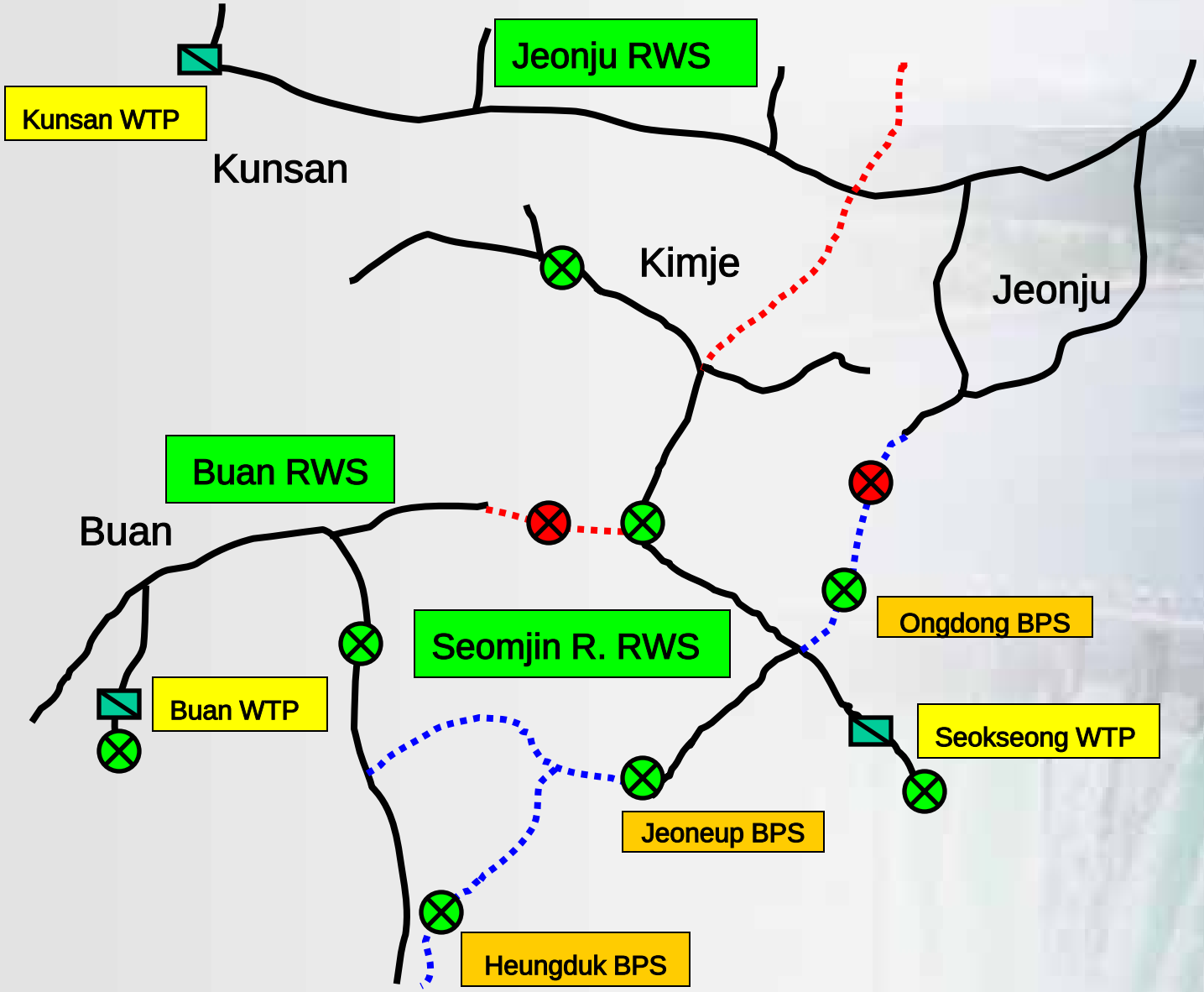
Status	RWS		LWS	
	Number of Systems	Capacity (1000 m^3/d)	Number of Systems *	Capacity (1,000 m^3/d)
Existing	5	757	12	412
Constructing	3	790	-	
Planning	2	650	1	21
Total	10	2,197	13	433

* Systems capacity greater than 10,000 m^3/day

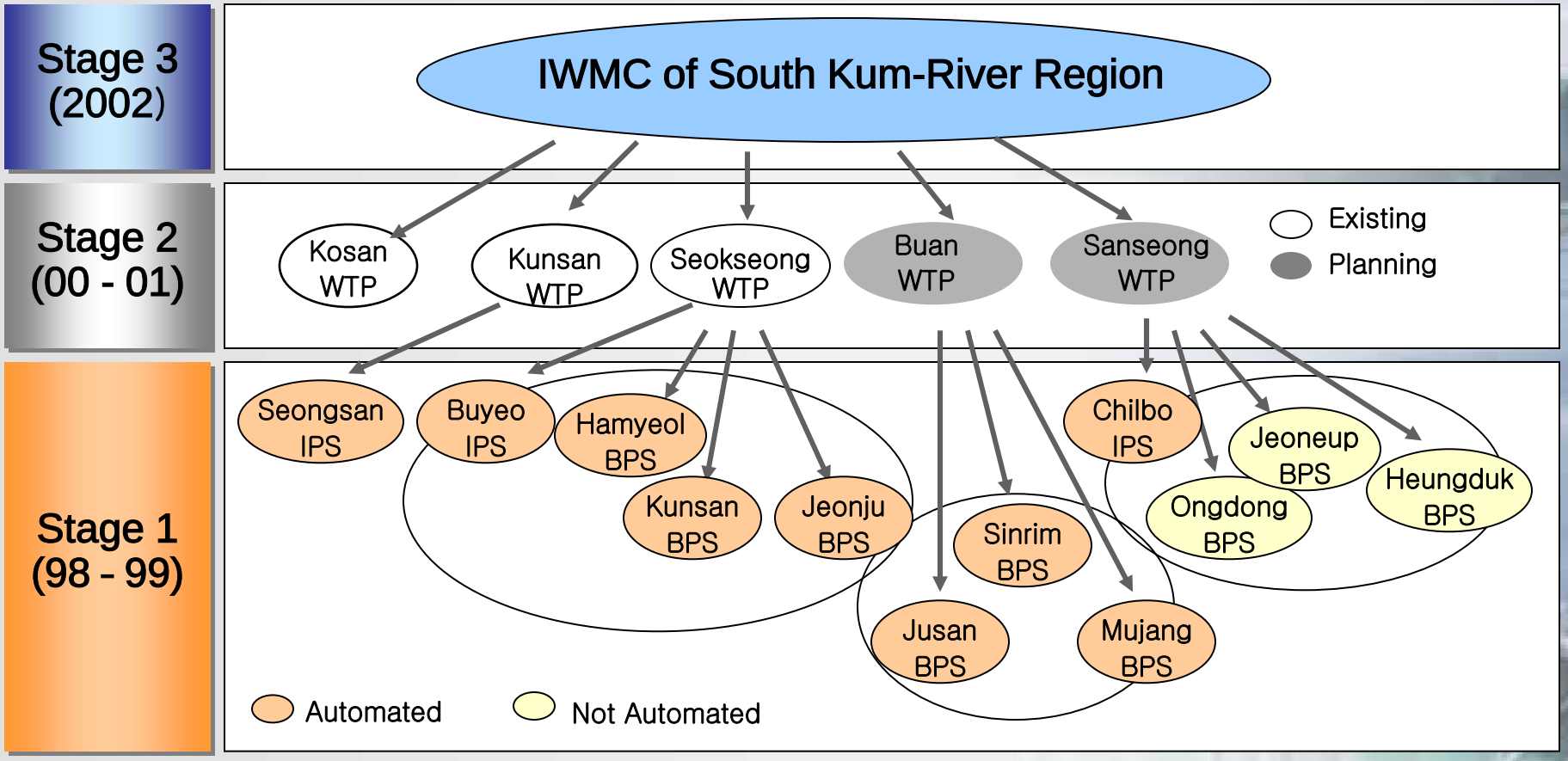
Location of South Kum-River Region



Water Transfer in South Kum-River Region



Integrated W-S Management System



- Save 0.75 million U.S. dollars per year (by diminishing 45 operators)

Results from IWMS Implementation

- Reliability
  - To acquire 420,000 m^3/d of water w/o developing water resources
  - Capable of responding emergencies (multi-sources and water transfer)
- Balance
  - Equitable water allocation
  - Possible to transfer water to regions of water shortage
- Efficiency
  - Efficient management (planning, design, operation, maintenance)
    - investment, qualified operators, preventive maintenance
  - Decrease of distance for water supply (average 20 km)
  - Water supply considering water quality