Scientific Support for Sustainable Water Resources Management in China

Yuanyuan Li

General Institute of Water Resources and Hydropower Planning and Design, Ministry of Water Resources, P.R.China
Emerging Changes of Water Resources
Rational from Science to Proper Policy
Major Works Bridging Science and Policy
OUTLINE

- Emerging Changes of Water Resources
- Rational from Science to Proper Policy
- Major Works Bridging Science and Policy
Emerging Changes of Water Resources

- Climate change and human activities impacts
- Increased load on natural resources & environment
- Change of eco-system’s structure and function
- Increasing of potential water related risks
Climate change and human activities impacts

With rapid development of economy, urbanization and large-scale afforestation, the cultivated land, forestland and urban land have all increased significantly.

The Nationwide

Beijing-Tianjing-Hebei Region
Impacted by the landscape change, the mechanism of runoff generation and assembling in many areas has been changed. The Haihe river basin: the average annual rainfall in 2001-2014 was the same as it was in 1980-2000, but the surface runoff was down by about 25%.

Rainfall - runoff graph

Linear relation of Rainfall- and runoff

- **Climate change and human activities impacts**
Increase load on natural resources and environment

With the continuous growth of population and economy, water ecological space has been compressed.
Increase load on natural resources and environment

With economic development, load on water and environment are also significantly increasing.

Change of sewage discharge

- Urban domestic sewage: Average annual growth 4.1%
- Industrial sewage: Average annual growth 3.8%
- Total sewage: Average annual growth 4.9%
Change of eco-system’s structure and function

- Shrinkage of aquatic eco-space

Urbanization & industrialization, farmland development cause the shrinkage of aquatic eco-space.

Since the 1950s more than 240 lakes with water area greater than 1 km² have significantly shrunk. The total shrinking area has been estimated to be around 14,000 km². Lake water storage capacity has also been reduced by 51.6 billion m³.
The number of natural lakes with areas of more than 6.67 hm² (100 mu) in the Hubei province has been reduced from 1,332 in 1960 to currently 728, a reduction of nearly 50%.
The development of water, land and mineral resources has led to significant changes of water circulation mechanism and the process of water resources.

- Changes of hydrological and ecological processes

- Change of eco-system’s structure and function

- Water circulation mechanism change caused by water and land development and utilization

- Significant change of basin runoff production caused by land use
Change of eco-system’s structure and function

- Significant change of watershed hydrological and ecological processes and landscape patterns in Yantazge.

- Glacial melt
- Tourism region
- Extreme climate
- Channel change
- Sea-level rise
- Wetland coverage
- Connectivity change
- Infrastructure: dams, mining industry, road
- Deforestation & water and soil loss
- Pollution
- Reduction in biodiversity

Notes:
- Climate change induced
- Interfered by human
Increasing of potential water related risks

Drought and flushing flood impact area seems increasing and the pollution contaminated accidents are also increased.

The rate of area affected by drought and the rate of area with drought disaster from 1950 to 2008.
OUTLINE

- Emerging Changes of Water Resources
- Rational from Science to Proper Policy
- Major Works Bridging Science and Policy
Rational from Science to Proper Policy

Emerging Changes
- Change of Nature
- Load on Nature
- Impact of Human

Change of water security
- Mechanism & process
- Quantity & quality
- Structure & function
- Risk & Variability

Coordinated development
- Water resources sustainability
- Economic development
- Ecology healthy
Coordinated development

Balances

- Human and Nature
- Carrying capacity and load
- Risks and Variability

Strengthening the regulation

- Nature: hydro-process & risk
- Human: demand, loads & impact

Aquatic eco-space and function
- Hydro-process dynamic
- Carrying capacity & load to nature
- Water right & water risks

Practical Polices Formulation & Implementation

Integrating Science & Policy

Rational from Science to Policy?
OUTLINE

- Emerging Changes of Water Resources
- Rational from Science to Policy
- Major Works Bridging Science and Policy
Major Works Bridging Science and Policy

- National Water Resources Assessment
- Balance sheet of water resources nature assets
- Evaluation on water resources carrying capacity
- Defining aquatic eco-space and redline
- River basin water allocation
- Implementing river chief system
General Approach of Water Resources Investigation and Assessment
Balance sheet of water resources nature assets

General approach of compiling balance sheet of water resources

- **Beginning amount**
- **Amount increasing**
  - Self-produced water amount
  - Inflow water amount
  - Return water amount of economic society usage
- **Amount decreasing**
  - Water withdrawal
  - Outflow
  - Water consumption of river and lake ecological system
  - Transfer to out of area

**Balance sheet**

- **Beginning amount** + **Increasing amount** - **Decreasing amount**

**Impacts on Nature**

- **Consumption of resources**
- **Environmental damage**
- **Ecological deficit**
Evaluation on water resources carrying capacity

- Water quantity
- Aquatic eco space
- Hydro-dynamic process
- Water quality

- Economy and society
- Water circulation processes
- Assessment index and methods
- Ecological system
- Water resource carrying capacity

- Water resource load

- Water resources carrying situation assessment

- Temporal and spatial evolvement of water resource carrying capacity and situation.

Establishment of water resource carrying capacity monitoring assessment and warning system.

General approach of water resources carrying capacity warning system
Defining aquatic eco-space and redline

- Spacial scale
- Natural condition
- Current load
- Key issues

- Rivers lakes
- Flood retention areas
- Water source areas
- Drinking water sources areas
- Soil erosion Prevention & control areas

- Redline for riparian zone
- Redlines for water ecological protection
- Redline for water protection zone

- Overall layout of water sector development
- Water infrastructure network system

General approach of water ecological redline
The development of water resources can not exceed the amount of available water resources.

The available water usually accounted for 1/3 of total water resources, should be the upper limit of development.

- The flood which is difficult to use and control
- The available water
- The minimum acceptable environmental flow

River basin water allocation
Integrated water resources management in watershed

River resources regime

Degree of water resources development

Demand of eco-environmental protection

Total amount of water resources

Basic demand of socio-economic water use

The constraint

Basic demand of eco-environmental water use

River basin water allocation

Maintain river health

Sustainable water use

Support economy development

Allocable water amount

Eco-environmental water need

Whether meet socio-economic demand

Production demand

Domestic demand

Whether meet eco-environmental need

Need of special species

Need of habitat

General approach of river basin allocation
Integrated water resources management in watershed

River resources regime  Degree of water resources development  Demand of eco-environmental protection

Total amount of water resources

Basic demand of socio-economic water use  The constraint  Basic demand of eco-environmental water use

River basin water allocation

Maintain river health  Sustainable water use  Support economy development

Allocable water amount  Eco-environmental water need

Coordination of different regions

River basin water allocation

General approach of river basin allocation
Implementing river chief system

River Chief System

Six Main Missions

- Water resources protection
- Aquatic eco-space protection
- Water pollution control
- Water environment remediation
- Water ecological restoration

Supervision and law enforcement

- Dynamic profile of the rivers
- Management targets
- Implementation plan

Completed, Intelligent, Digitized Rivers and Lakes Management System
Thank you!