Proposal for New Study of Sustainable Water Resources from China

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Outline

• *Emergency water issue*
• *Major challenge*
• *Water research in CAS*
Emergency Water Issue
China is a developing country with a variety of climate & much stress from its population & economic development.
Flood feature in China

- High peak discharge & large flood volume

Maximum discharge comparison

(Duan H.D, 2005)
Total water use / usable water resources in China
Vulnerability of Water resources & Ecosystem in the Western China

Natural regionization

Dry Area in inland

Grassland in semi-arid

Yellow River

- 0~200 mm
- 200~400 mm
- 400~600 mm
- 600~800 mm
- 800 mm以上
Water issues & related eco-system problem in the west China is very significant
e.g., Shiyang River in Gansu, Tarim river in Xinjiang etc.
Un-safety drinking water issue in rural area of China

- Population of un-safety drinking water reaches 0.323 billion in China

Population situation of drinking water at rural area

Un-safety drinking water

- Water quality: 70%
- Water quantity: 30%
- Safety: 66%
- Un-safety: 34%
Water problem is well known in the world.
Major Challenges
Climate Change is a big issue in the world, that already shown its significant impact to earth system and hydrological process.
Tendency coefficient of annual mean surface air temperature over China from 1951 to 2004 (Ren, 2007)
Trends of days with heavy rain in summertime (April to September) during 1951-2000.

Trends of days with heavy rain in summertime
Blue color denotes increase, red color denotes decrease and cross denotes excess of the 95% significant level.
(Zhai, et al., 2005)
温度超过 2℃，全球遭遇沿海洪涝、饥饿、疟疾、水短缺的人数将大大增加。

(丁一汇)
Big Challenges (挑战问题)

- Existing or planning water projects and water resources programming do not fully consider potential impact of climate change.

- One of major challenges is lack of available & workable screening tool to assess such impact and take adaptation management to the potential impacts of climate change.
Point II: Human activity impact

- It was shown that human activities on water issue in China are very significant due to population stress & economic development:
  - urban / agricultural development,
  - river development (i.e., water project construction)
  - water use, particular on over exploitation of ground water resources
  - others
Chang & trend of the total water use in China (Unit: 0.1BCM)

- Total water use
- Agriculture water use
- Urban water use
- Domestic water use

Diagram showing the water use trends from 1949 to 2005.
Vision 1

- Water use in agriculture occupies almost 70-80% of total water use amount.

- Water demands of both urban water & domestic water are continually increasing due to social & economic development.
## Cause Analysis

**Conflict between the economic-social development & the carrying capacity of water resources**

*Case Analysis of the Haihe River Basin*

<table>
<thead>
<tr>
<th>Indexes</th>
<th>Beginning of 1950s</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urbanization</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>GDP</td>
<td></td>
<td></td>
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<tr>
<td>Water resources per capita</td>
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</tbody>
</table>
Rate of runoff decrease is much more serious than that of precipitation.

Over exploitation of ground water:
- 100 billion m³

Water shortage in 2000:
- 8 billion m³

Water conflict
Urban development & over use of ground water

- Big depth of ground water concerted in urban area due to continue water using behavior in the city.
Environmental Degradation

Water shortage

Unhealthy water cycle

Renew-ability of Water Cycle / Rehabilitation

Surface Water:

Ground Water

Environmental Degradation

Water shortage
• How to recover a **healthy water cycle**?

• How to define a reasonable **Yellow line (Warning) & Red line (Control)**?
Water Research in CAS
Chinese Academy of Science is the national scientific research body

Water Cycle & Water Security in China is the priority issue in resources & environmental fields

- Key Lab. of Water Cycle & Related Land Surface Process, CAS
- Water Resources Research Center, CAS
- Others
Major directions on water research

- **Policy:**

  - Basic research
  - Application research

  Encouraging scientific problem’s research of national key demands for water issue
Major Basic Research

- Water cycle & hydrological process in complex natural & social system
- Urban Water & Eco-hydrology
- Geographical process change and water dynamic mechanism of land surface system (water, soil, atmosphere & ecosystem etc.)

Observation $\rightarrow$ modeling $\rightarrow$ understanding
Water Research bodies in Institute of Geographical Sciences & Natural Resources Research, CAS

Center for Water Resources Research, Chinese Academy of Science

- Natural Geography & Environmental Science
- Human dimension Geography
- Resources Sciences
- Ecology
- Informatics of Earth System
- Research Center of Land Surface System
- Research Center of Human dimension & Geography
- Research Center of Resources Sciences
- Research Center of Agriculture Policy
Center was lunched in Dec., 2006
Encouraging research by interdisciplinary approach of water system.

Encouraging combination of water research and water management & utilities to support making decision on national or regional water policy.

e.g.,

- *Integrated River Basin Management* to link major aspects of water cycle, water resources management to environmental change & keep water sustainable use.
Key Lab. of Water Cycle & Related Land Surface Processes, Chinese Academy of Sciences
Climate change

Human Activity

SPAC Process

Hill Slope Pro.

River process

Land Water Cycle

Local scale  →  Slope/River Scale  →  Basin Scale  →  Continent Scale

Four major branches

Climate change

Human Activity

Urbanization

Urbanization

Local scale

Slope/River Scale

Basin Scale

 Continent Scale

SPAC Process

Hill Slope Pro.

River process

Land Water Cycle
Good Teams on Land Water Cycle, Sedimentation, Hill slope erosion
Multiple Approaches are encouraged on water research

Spatial Observation

Approaches

Modeling

Field observation & experiments
2. High quality and capacity on Water Cycle Experiment in China
1. Very strong Physical Simulation System in Key Lab. of Water Cycle in Beijing
Multiple physical models for urban & rural water processes experiments
物理模拟、水化学及同位素分析室内实验平台

物理模拟实验场
河道与地壳抬升装置
环境同位素分析仪

水质分析仪
型气体同位素比值质谱仪
型型元素分析仪

水中氧同位素的制备
水中氢同位素的制备
矿物氢同位素的制备
Field observation network
Distribution of field experimental catchment

Water observation & experiments network, Key Lab. of Water Cycle & Related Land Surface Processes CAS

China CERN Network

RS (MODIS etc.) & its cover areas

Ground water monitory network

SPAC system observation
Major Tasks: Understand water cycle process impacted by *climate change* and particular *human activity of high intensity*
Water Action & Plan in CAS
The Notion of a Global Water System

Water System is such a water cycle and interaction system that is linked among physical component, biological & biogeochemical component and human component.

Integration across elements is a central GWSP Focus.
Two key bodies

- The Chinese National Committee of the Global Water System Project (GWSP-CNC)
- The Asia Network Science Office of Global Water System Project (GWSP-ANSO)

were established in 2003 and 2006 respectively, to promote the involvement of the Chinese water community in global water system research.
e.g., the Asia Network activity

International East Asia Regional Workshop of International Academy Panel (IAP) on the Water Security to Climate Change and Human Activity

12-15, June 2006
Beijing, China

Sponsored by:
- Chinese Academy of Sciences (CAS)
- International Academy Panel – Water Program (IAP-WP)
- Federation of Asian Scientific Academies and Societies
- The Association of Academies of Sciences in Asia

Organized by:
- Key Laboratory of Water Cycle and Related Land Surface Processes
- Institute of Geographic Sciences and Natural Resources Research
- Chinese Academy of Sciences
International East Asia Regional Workshop of IAP on Water Security

Beijing, China
June 12-15, 2006
Research Projects

- Cross-basin Water Diversion Projects and Their Impacts on the Hydrological System and Water Security, supported by the Chinese Academy of Sciences, 2007-2009
A water system model

- It was developed to support not only the assessment of climate change and human activities, but also the impacts of cross-basin water diversion projects on water security.
Others


- China Water Cycle Observation Plan (MOST, 2008-2012)
Major Application Basic Research

- Water saving & management in Urban & agriculture areas
- Eco-water & water project impact and comprehensive operation to river health
- Ground water sustainable use & protection
- Water system & Climate changing impact assessment
- Integrated Water Management
- Others

Survey → modeling → assessment → consulting jobs
中英国际合作咨询项目
气候变化对水资源影响的适应性评估与管理框架
：中国实例研究
Screening for Climate Change Adaptation:
Managing the potential impacts of climate change in China
Developing a climate change screening process to identify and manage climate change impacts on development investments.

This will be achieved by piloting a process of sample using case study projects in the water sector in China.

- 任务 (Task)
  - 开发一种气候变化对水资源影响的适应性评估框架，识别和管理气候变化对开发投资的影响。
  - 通过中-英合作和针对中国水问题多个实例研究总结提出有价值的气候变化影响评价工具。
### Framework of screening climate change impact

<table>
<thead>
<tr>
<th>Phase</th>
<th>Steps</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project description</td>
<td>Descriptive overview of each Case Study</td>
</tr>
<tr>
<td></td>
<td>Problem analysis</td>
<td>Rapid strategic descriptive summary</td>
</tr>
<tr>
<td></td>
<td>Identify climate-sensitive components</td>
<td>Identify climate-sensitive components</td>
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<tr>
<td></td>
<td></td>
<td>Identify relevant quantitative project objectives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify appropriate indicators</td>
</tr>
<tr>
<td>2</td>
<td>Semi-quantitative analysis of impacts</td>
<td>Develop scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compare levels of stress in each scenario against project objectives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– can it cope?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assess need for adaptation</td>
</tr>
<tr>
<td></td>
<td>Quantitative analysis of adaptation options</td>
<td>Identify adaptation options</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estimate costs of each adaptation option</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estimate costs of damages (without adaptation)</td>
</tr>
<tr>
<td>3</td>
<td>Multiple Criteria Analysis</td>
<td>Evaluate preferred option (including ‘No changes currently needed’)</td>
</tr>
</tbody>
</table>
Suggestion to select representative basins as case study of China in the project:

- Shiyang River Basin, North-West China
- Hai River Basin, North China
- Huai River
<table>
<thead>
<tr>
<th>Case Study Development project</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood control and land drainage management project</td>
<td>Huai River Basin</td>
</tr>
<tr>
<td>Management of Miyun reservoir for water security for Beijing</td>
<td>Chaobai in Hai River Basin</td>
</tr>
<tr>
<td>Water Conservation Project: Agricultural water use efficiency</td>
<td>Hai River Basin</td>
</tr>
<tr>
<td>Integrated Restoration Plan for the Shiyang River Basin</td>
<td>Shiyang River Basin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>区域</th>
<th>江淮流域</th>
<th>华北地区</th>
<th>西北地区</th>
</tr>
</thead>
<tbody>
<tr>
<td>问题与分析目标</td>
<td>洪水灾害问题</td>
<td>农业水资源与政策</td>
<td>流域径流变化与城市供水</td>
</tr>
<tr>
<td>CASE</td>
<td>淮河</td>
<td>海河流域</td>
<td>密云水库</td>
</tr>
</tbody>
</table>
Products

- 项目总结摘要（页，中、英文）
  Project summary (4 pages) in both Chinese and English;

- 项目总报告（页，中、英文）
  Project Final Reports (20 pages) in both Chinese and English;

- 项目中国实例研究报告（页，中、英文）
  China climate change and Four case study reports (20 pages) in both Chinese and English;

Thank for NDRC & DFID supports, Thank for all Chinese & UK experts for your doing good jobs!
Proposal for Cooperation Research on Water Security in China
2007 IAC Board Meeting, Amsterdam, 29-31, Jan. 2007
Critical Global Water Problems addressed by IAC was discussed

- **Drinking Water Issue** (Surface/Ground Water)
- **Agricultural Water Issue**
- **Urban Water Issue** (recycling water etc.)
- **Eco-water issue** (river, lake, wetland, land & coast eco-system etc.)

- **Scale**: Global & regional water system
- **Aspect**: water quality & quantity
Proposal for new study on sustainable water resources by CAS

(1) Developing the task (project) of Climate Change Impact to Global & Regional Water Security

Major area:  Health water cycle & sustainable water management on Drinking Water, Agricultural Water, Urban Water, Eco-water
(2) Supporting a number of key international cooperation projects of new study on regional sustainable water resources

a. **Integrated study on water cycle & water security**
   - **clear drinking water** in rural area
   - **water recycling** in urban area

b. **Sustainable water uses in the process of globalization**
   - **agricultural water**

c. **Impact of water projects on water cycle and ecosystem restoration**
   - **eco-water**

d. **Global water observation & water system**
Case studies in China

Arid Semi-arid Semi-humid Humid

Yellow River

Hei River

Hai River

Songhua River

Wuding River

Yangtze River

Poyang Lake Basin

Zhujiang River
International cooperation will be very benefit!

Thank you!

Prof. Xia Jun,
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