Water Ecological Protection Strategies in China: Challenges and Measures

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Outline

- Characteristics of water environment in China
- Issues and challenges
- Strategies and measures
**Limited Water Resources Availability**

- 2841 billion cubic meters (BCM) in total (7% of the world value)
- 2100 m³ per capita (<1/4 of the world average)

**China’s water resources composition (BCM)**

- Surface water: 2738.8
- Groundwater: 821.8
- Double counted: 719.4
- Total: 2841.2

**Water resources per capita (m³)**

- Russia: 29000
- USA: 9916
- Japan: 4429
- India: 2450
- China: 2100
- World average: 8930
Uneven Temporal Distribution

- 74% in spring and summer, 26% in fall and winter
- Variation in river runoff between dry and wet years: 2-6 times
Uneven Spatial Distribution

- 22% of water resources in North China, possessing 38% of population, 46% of arable land area, and 63% of food production.

Water resources per capita (m³) in the Yellow, Huai, and Hai (YHH) River basins:

- South China: 3302
- North China: 909
- YHH region: 457

Precipitation contours of China
Fragile Aquatic Ecosystems

- More than 60% of nationwide area is very fragile, including arid and semi-arid regions, associated with naturally vulnerable aquatic ecosystems, such as those in the Tibetan plateau.

Ecologically sensitive areas

(More red means the region with a higher risk of ecological degradation)
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Degraded Aquatic Ecosystems

- Due to over-exploitation and climate change
- Low forest coverage rate (the reason and the result)
- Soil erosion increased
- Surface water area shrunk, floodplain occupied
- Aquatic habitats destroyed
- Flow regimes disturbed
Water resources development ratios (exploitation amount / storage amount) for river basins in North China

Groundwater over-exploitation areas (red)

Water shortage areas

(Red: extreme shortage, dark yellow: significant shortage, pale yellow: moderate shortage)
Relative changes in water resources during 1980–2000, compared to 1956–1979

Severe soil erosion regions (blue)

Change in the surface area of the Dongting Lake

Forest coverage rate
Insufficient Water for Ecosystems

- Too much water used by humans
- Environmental flows for nature: hard to be guaranteed

![Bar chart showing deficient runoff values (%)](chart)

Deficient runoff values (in percentage) of selected rivers in North China relative to environmental flows for ecosystem use.

Deficient runoff (%) = (Environmental flow - annual runoff) / Environmental flow × 100%

- Shule: 65.2%
- Shiyang: 57.3%
- E. Liao: 44.3%
- W. Liao: 39.2%
- Southern Hai: 24.4%
- Hei: 20.8%
- Northern Hai: 17.4%
- Tuma: 14.1%
- Daling: 12.8%
- North of Tianshan: 11.3%
Severe Water Pollution

- Only 47% of water function zones meet water quality requirements
- 72% of tested groundwater wells with water quality at Grades IV – V
- 32% of national rivers fed with pollutants higher than their capacities
- 35% of monitored cross-sections of major rivers worse than Grade V

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description of water use</th>
<th>COD</th>
<th>NH4-N</th>
<th>DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>National conservation reserves, water source protection zones</td>
<td>≤2</td>
<td>≤0.15</td>
<td>≥7.5</td>
</tr>
<tr>
<td>II</td>
<td>Drinking water 1st Class; natural habitat for sensitive and rare aquatic species; fish and crustacean spawning; fish rearing</td>
<td>≤4</td>
<td>≤0.5</td>
<td>≥6</td>
</tr>
<tr>
<td>III</td>
<td>Drinking water 2nd Class (treatment required); sanctuaries for common aquatic species; fish survival in winter; fish migration; aquaculture; contact recreation</td>
<td>≤6</td>
<td>≤1</td>
<td>≥5</td>
</tr>
<tr>
<td>IV</td>
<td>Industrial use; active non-contact recreation</td>
<td>≤10</td>
<td>≤1.5</td>
<td>≥3</td>
</tr>
<tr>
<td>V</td>
<td>Industrial cooling only; agricultural irrigation; ordinary (low conservation value) landscape irrigation; passive recreation</td>
<td>≤15</td>
<td>≤2</td>
<td>≥2</td>
</tr>
<tr>
<td>VI</td>
<td>Not suitable for any purpose</td>
<td>&gt;15</td>
<td>&gt;2</td>
<td>&lt;2</td>
</tr>
</tbody>
</table>

Source: Speed et al. (2016)
Inefficient Water Management

- Regulatory system needing to stress environmental protection
- Policy and legislation to be more practicable
- Rule enforcement to be strengthened
- Responsibilities of management agencies to be reconciled
- Accountability for water related actions to be clarified and overseen
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# Objectives of Improving Water Ecology

## Issues

- Degraded aquatic ecosystems
- Insufficient water for ecosystems
- Water pollution
- Inefficient management

## Goal

- Reconciliation between water environment and humans

## Objectives

- To consolidate the protection of areas important for aquatic ecosystems
- To implement water environment restoration
- To guarantee environmental flows
- To improve water governance
Strategies and Measures

- Protecting water related areas

  - Determining sensitive areas and functions for aquatic ecosystem conservation (e.g., areas for waterbodies, headwater, soil erosion, flood control, drinking water sources, etc.)

  - Alleviating soil erosion, conserving headwater, floodplain, and important catchment areas

  - Increasing the forest/vegetation coverage rate

  - Controlling/prohibiting activities adverse to the environment (e.g., land reclamation, pollution discharge, sand excavation, etc.)

  - Rigorously justifying the construction of new projects based on carrying capacities
Strategies and Measures (cont’d)

- **Restoring water ecosystems**
  - Restoring river, lake, and wetland conditions by improving catchments, flows, floodplains, banks, channels, habitats, organisms, and water quality
  - Retrieving farmland to convert to lakes and wetlands
  - Reducing human disturbances
  - Recovering hydraulic connections between waterbodies
  - Rehabilitating aquatic biodiversity
Strategies and Measures (cont’d)

- Guaranteeing environmental flows

- Determining environmental flows in rivers, lakes, and wetlands
- Operating water conservation facilities to meet environmental flows
- Diverting water to resolve deficiency
- Allocating water resources quotas to human activities
- Increasing water use efficiency
- Renovating existing facilities and justifying new projects for environmental flows
- Monitoring and collecting flowrate data for oversight
Strategies and Measures (cont’d)

- Modernizing water resources governance

  - Establishing monitoring system to oversee unacceptable activities with punishment
  - Strengthening water use control through taxation, water rights trading, pricing, and water consumption quota allocation
  - Strictly enforcing regulatory instruments
  - Improving administration efficiency, flexibility, and resilience
  - Incentivizing community participation
Thanks for attention

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