EURASIAN WATER CONFERENCE
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Urban solutions for global challenges
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Sustainable development of drinking water security technology in China

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The impact of global warming on water security is **significant and multifaceted**.
Content

1 Overview of China’s Drinking Water Security

2 Challenges of China’s Drinking Water Security

3 Countermeasures and Suggestions
1.1 Water is one of the most important resources of human society in the future

- Water resource is more precious than oil, water crisis is more dangerous than the leakage of nuclear, and the water war occurs more easily than land grabbing in the future.

- Water is the source of life and the birthplace of civilization, the rise and fall of each civilization is closely related to the control and utilization of water sources by human.
1.2 Water safety issues have got great attention in the global

➢ In 2017, WHO and UNICEF reported that about 2.1 billion people worldwide still have no access to safe drinking water, and 844 million people do not even have access to basic drinking water services.
1.3 China attached great importance to water security issue

➢ Our leaders have taken the water security very seriously: China attach great importance to water security issue, from the strategic perspective with building a moderately prosperous society in an all-round way and achieving the sustainable development of the Chinese nationality.

➢ From 2007, National Science and Technology Major Project of “controlling and harnessing of water pollution” was implemented for solving the problem of water. Drinking water subject is one of the most important research topics.
Water quality improved significantly

Surface water quality is improved

During 2001-2017, the water quality of major rivers in China has been improved: the class I-III increased by 38.4%, inferior V class decreased by 35.7%.

Water quality standards were significantly improved.

China’s urban centralized drinking water water qualification rate continue to improve, surface water qualification rate improved from 76.5% in 2010 to 93.7% in 2017.
1.4 To solve the drinking water safety problem facing a series of challenges

➢ Because of the rapid development of industrialization and urbanization, as well as the effects of global climate change, drinking water safety problems in China face many challenges.
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2.1 Water resources shortage

- Water resources per capita in China are approximate 2350 m$^3$, which are only 25 percent of the world average level.

- More than 400 cities are severe water-shortage or lack of water;

- By 2030, the population of China may be more than 1.5 billion by 2030 with per capita water resources only 1800m$^3$, which is close to the per capita water resources cordon.

The map of China's water shortage cities
Less water due to climate change

Climate change leads to more significant evaporation on the surface, with soil water content declining, river runoff decreasing, lakes shrinking, reservoir storage decreasing, and wetland functions declining.

Climate change is causing glaciers to shrink. In this case, the availability of water in the lower reaches will collapse.
In northern China, rainfall in summer is about 62% of the whole rainfall throughout one year.

The time and spatial distribution of water resources is not matched between the development demand and the water resource conditions, which result in the water shortage crisis in China.
Climate change has caused the spatial and temporal distribution changes of rainfall in some areas, altering the local hydrological cycle and affecting the quantity and quality of water resources.
2.3 Deterioration of water ecological functions in China

- **Plenty of water due to climate change**
  - **Heavy rainfall**
    Climate change increases the temperature and improves the water carrying capacity of the atmosphere. The frequency and intensity of heavy rainfall will increase, which will easily lead to urban waterlogging.
  - **Tropical cyclone**
    Climate change has led to rising sea levels, higher water temperatures in the upper layers, increased frequency and intensity of tropical cyclones, and threatened coastal flooding.
  - **Glacial lake expansion**
    Climate change leads to glacial recession, which in the short term causes the flow of the downstream river to rise and the glacial lake to expand. Once the glacial lake breaks its Banks, floods are likely to occur.
Waterlogging happens

- Water ecology in some Chinese cities is unbalanced, and waterlogging often occurs, causing pollution of urban water bodies.

- October 8, 2015
  Heavy rains hit Fuzhou, Fujian province

- June 16, 2016
  Heavy rains hit Changsha, Hunan province

- April 8, 2017
  Heavy rains hit middle and lower Yangtze river

- July 6, 2018
  Heavy rains hit central and western China
2.4 Serious water pollution

- The scope of surface water pollution has been spread from the tributaries to the main stream, the downstream to the upstream.
  - In 2017 the national surface water 1940 evaluation, evaluation and ranking section (point), III class below 32.1%;
  - Among the seven major river basins, haihe river basin is heavily polluted.

- Groundwater pollution is spreading from spot and strip to surface, permeating from shallow layer to deep layer and spreading from city to surrounding area.
  - In 2017, the proportion of poor and extreme groundwater quality was 51.8% and 14.8%, respectively.
  - The evaluation results of groundwater monitoring Wells are generally poor.

2017 Surface water quality

- I-III类 68%
- IV-V类 24%
- 劣五类 8%

2017 Ground water quality

- 极差级 15%
- 优良级 25%
- 良好级 23%
- 较差级 52%
- 较好级 1%
Water is poor due to climate change

- Water quality deteriorated during the floods
  - Heavy rainfall brings a large amount of surface pollutants into the water and resuspends the sediment in the bottom

- Water quality deteriorated during the drought
  - The river and lake shrinks, and the concentration of nutrient in the water increases significantly

- Eutrophication of water
  - Heavy rainfall brings a large amount of nitrogen, phosphorus and other nutrients to the water. On the other hand, the water temperature increases
The interaction between water issues such as water shortage and pollution make the drinking water security issue become **urgent, complex and grim**. This will not only increase the difficulty and cost of water treatment, but also increase the environmental and health risks, constraining the sustainable development of economy and society, hindering the construction of ecological civilization.

With the new requirements of ecological civilization construction, the new expectation of people’s livelihood, what can we do to protect drinking water safety?
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3.1 Water environment regulation is a demand for China's green development

National ecological and environmental protection conference of China reported a right direction for the future of our country’s promotion of green development in 2018. It proposes solutions for world environmental protection and sustainable development and guides international cooperation on climate change. In terms of safety and protection of drinking water, the focus of future work is to further advance from theoretical breakthroughs to practice, and focus on solving the problems of water environment, and resolutely fight pollution prevention and control.
Environmental management system

• Permit system of pollutant discharge

➢ The ministry of ecology and environment of P.R.C. is studying to formulate “permit system of pollutant discharge”.

➢ In the 20th century, permit system of pollutant discharge in Germany, France, Hungary have been successfully implemented, which are advanced experience for China to learn and promote the sewage permit system reform.
At present, the river chief system has been fully implemented throughout the country. At the same time, we should rely on "river chief system" to establish "river chief wisdom" and realize "river chief governance".

Implement the strongest water resource management system and strive to fight the battle of clean water.
3.2 Solving water shortage problems

- Facing the situation of water shortage under climate change, we should strengthen water resources development, improve water efficiency and build a water-saving society.

- **Reclaimed water recovery**
  - Sort: push back process
  - Priority: agricultural and industrial
  - 2020, lack of water industry reused water > 20%

- **Rainwater**
  - Sponge city, low impact development
  - Rainwater collection and utilization: infiltration, storage, utilization, drainage

- **Seawater desalination**
  - Membrane desalination and thermal desalination
  - Desalination based on renewable energy
The sponge city construction in China can learn from the new ideas of foreign rainwater resources utilization and drainage basin water pollution treatment, and carry out urban water environment treatment according to local conditions.
Strengthen new energy development

- IPCC: Large amounts of greenhouse gases are a direct cause of climate change
- Energy conservation and new energy development are the fundamental ways to mitigate climate change.
- New energy development is an important component of China’s energy structure adjustment, providing abundant clean power for China’s water security
- Demand: High efficiency and stability techniques in seawater desalination and sewage treatment
The malodorous black river must be thoroughly eliminated.

- Certain policies had been put in 2015 which required to generally eliminate the malodorous black river by 2017 in most Chinese cities.
- At present, there is a lack of comprehensive solutions to break through the node barriers of each technical route and solve the practical problems.

- The treatment of malodorous black river is urgent and the task is heavy.
  Advanced pesticide management, fertilizer use restrictions and water treatment are needed to resolve the malodorous black rivers.
Public-Private-Partnership

The malodorous black river treatment market is huge and needs a lot of money.

- According to the measured, the size of China's market for the malodorous black river treatment is expected to be 400 billion RMB, and surpass 1000 billion RMB.

- Chinese government encourages international environmental protection enterprise to participate in the malodorous black river treatment.
3.3 Aiming at the World Frontier for China’s Drinking Water Technology Innovation

Food Chain Reactor (FCR) Garden type sewage treatment technology:

FCR originated in Hungary. It is composed of a series of biochemical reactors in series, which use fixed biofilm and suspended biodegradation of pollutants in water. It covers an area of over 60% less than that of activated sludge method. Less than 30% of operating costs; Low sludge yield; Intelligent process control.

◆ With high efficiency and natural integration with urban environment, FCR can provide a good reference for the upgrading of China's sewage treatment plants.
(1) “Integrated” emergency water security system

➢ Based on the big data platform and intelligent terminal, build the emergency water security system.

➢ **Demand**: Sensor system development, digital model building, regulatory capacity building and big data, cloud computing, Internet technology integration

![Integrated monitoring system](image.jpg)

- **water quality**
- **Water safety robot**
- **Amount of water**

**Cloud Computing**

- Automatic monitoring
- Risk early warning
- Business management
- Public service

**Integrated monitoring system**

Real-time monitoring

Integrated information system

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(2) Development of novel materials to promote water purification technology

- Membrane water treatment technology can reduce the emissions of greenhouse gas compared with traditional biochemical method.

- Deficiency: New materials and mechanism research of membrane separation.

Molecular dynamics simulation was successfully used to explore the internal microstructure of membrane materials.

Analysis of membrane separation process from new aspects.

Molecular simulation of the water permeating through the membrane.


(3) Development of water safety robots

Robots: Instead of manual continuous inspection and routine maintenance of high-risk equipment; Targeted removal of contaminants that cannot be treated by conventional water treatment processes. Facilitate the construction of "intelligent" waterworks in China in the future.
Using intelligent technologies such as robot and video identification, establish production inspection system, water quality analysis system and emergency treatment system to manage the whole production process of waterworks.

3.4 To build a new “intelligent waterworks” in the future
The natural condition of China's rivers and lakes are complex. Water resources distribution is very uneven. Chinese economic and social development does not match with present water supply.

As the largest developing country, Chinese government is working to solve the water shortage and water pollution problems in order to build a moderately prosperous society and promote the construction of ecological civilization. Now we have gotten remarkable achievements.

We believe that water problem can be properly solved and water resource sustainable utilization will be realized, under the help of international communication and rational regulation and management as well as public participation.
Thank you!