WATER SCIENCE AND TECHNOLOGY

WATER SCIENCE AND TECHNOLOGY IN CHINA

MINISTRY OF WATER RESOURCES, PEOPLE'S REPUBLIC OF CHINA

Water Science and Technology in China

1. Main Achievement and Challenges

1.1 Main Achievements

China has made noteworthy achievements in scientific research, technological development, and promotion and commercialization of research results related to water resources. Water science and technology in China centers on the central tasks of the water sector, serves the overall interests of the country, enhances its supporting role and ushers in future developments. At present, water science and technology in China

Bird's eye view of Three Gorges Dam

are up to advanced international standard in general, with individual areas such as sedimentation, small hydropower, dam technologies, and soil & water conservation already taking the lead in the world.

1.1.1 Marked Achievements and Capacity Building in Water Science and Technology

Based on practical experiences of water governance, the Chinese government vigorously advocates innovation in water science and technology, actively applies new and high technologies to reform traditional water management, and steps up efforts to introduce scientific approaches in the construction and management of water works. As a result, important achievements have been made in scientific and technological developments of the water sector, which is witnessed in the following key areas:

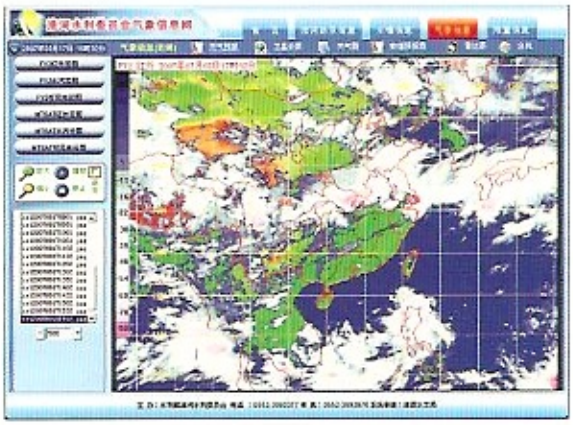
- Research on flood control and disaster mitigation: Advanced technologies are extensively applied in the projection, forecasting, early warning and information collection of floods, the commanding system of disaster relief, as well as flood control and emergency rescue work, resulting in marked enhancement in capacity building for disaster preparedness and reduction. In addition, a national commanding system for decision-making in flood control in all the seven major river basins is under construction.
- Comprehensive governance of major rivers: Key scientific experiments and research on water and sand regulation of the Yellow River, and warping in the Longmen-Tongguan Section (also called small main stream in the north) of the Yellow River have contributed to faster solution to the imbalance of water and sediment in the Yellow River. In addition, such new technologies as anti-seepage reinforcement of dykes, and detection and sensing of loopholes and defects have been applied to the construction of dykes along the main stream in the middle and lower

reaches of the Yangtze River. All these have greatly improved the quality of water project construction.

- Conservation and protection of water resources: the research and application of assessment methodology regarding the carrying capacity of water resources, the theoretic and practical progress in water right and water market, as well as development and promotion of new water-efficient technologies and facilities, have jointly promoted the building of a water-saving society.
- Rural water conservancy: By upgrading traditional irrigation technologies and facilities, optimizing distribution of water resources in irrigated areas, and promoting application of new technologies and products of rural hydropower, we have accelerated the modernization drive of rural water conservancy.
- Construction of water works: Such advanced technologies and devices as the tunnel boring machine (TBM), shield-driven tunneling method and super large scale forced pre-cooling concrete mixing story have been applied, rendering enormous help to the modernization of water work construction.
- ICT development for the water sector: With the wide use of computer communication network technology, basic data could be automatically captured, transmitted, stored and processed on a 24/7 real-time basis. The database for basic hydrological data is developed at a faster pace. As such, the water sector in China has markedly enhanced its ability to serve the public with relevant water information

1.1.2 Better Achievements Resulting from Introducing and Promoting Overseas Water Technologies

Starting from the 9th Five-Year Plan period, China has introduced more than 800 advanced practical technologies, devices and facilities that match the characteristics of its water sector from over 20 countries and regions, including USA, Australia, Japan and Europe. These technologies, devices and facilities cover a variety of subjects, such as development, utilization and rational allocation of water resources, disaster preparedness and reduction, rural water conservancy, water and soil conservation, monitoring of water environment and ecological governance, as well as project construction and management. The introduction of advanced technologies has significantly elevated the overall level of water science and technology in China, and boosted its continuous future development. By implementing projects and plans including the National Project for Funding Application of Advances in Agricultural Science and Technology,



Information system of flood defense in the Huai River

Plan of the Ministry of Water Resources on Promoting Key Scientific and Technological Research Results, and Local Plan on Promoting Scientific and Technological Development, China has realized commercialization of about 1,000 practical water-related scientific and technological advances, which has played a significant role in upgrading disaster preparedness and reduction, highly-efficient water use in agriculture, water and soil conservation, and hydraulic construction.

1.1.3 Initial Shaping of the System for Innovation in Water Science and Technology along with Its Infrastructure Platform

Up to now, China has established a system for innovation in water science and technology at the three layers of the State, basin and sub-national administrative region. The national innovation bases are located in two non-profit research institutions, namely, the China Institute of Water Resources and Hydropower Research (IWHR) in the north and Nanjing Hydraulic Research Institute (NHRI) in the south. Basin-specific innovation platforms are also built with researchers mainly coming from the Yangtze Water Resources Commission and the Yellow River Conservancy Commission. In addition, regional hydraulic research centers and hydraulic experiment stations have also been established, with researchers from local water authorities as their backbone human resources. Meanwhile, China has enhanced the development of infrastructure platforms to support water science and technology. 5 key national laboratories on water resources and 4 national engineering technology research centers are in operation in China. The Ministry of Water Resources has also founded 10 ministerial key laboratories and 13 ministerial engineering technology research centers. With a view to enhancing capacity building for tackling water-related problems, China has also built a group of key laboratories, engineering technology research centers and scientific experiment bases at the provincial level, including, among others, 10 irrigation experiment stations, 45 hydrological experiment stations and over 130 water and soil conservation experiment stations.

1.1.4 Ever Enlarging Talent Pool in Water Science and Technology

At present, China has a pool of over 340,000 professional and technicians in water science and technology, among whom 148,000 have medium or advanced qualifications. Under the Ministry of Water Resources, there are 4 non-profit research institutes, in which 70% of all researchers have masters' or doctoral degrees. A large number of young talents in science and technology are trained. 85% of all researchers participating in national, provincial or ministerial

MWR staff taking master courses in UNESCO-IHE

science and technology projects are young backbone talents in their respective organizations.

1.2 Challenges

In today's China, problems such as drought & water shortage, flood & logging, water pollution, and soil erosion remain acute, whereas the conflict between socioeconomic development and the carrying capacity of water resources and the water environment keeps intensifying. Further proceeding of industrialization and urbanization and increasing impacts of global climate changes expose China to even more severe water problems.

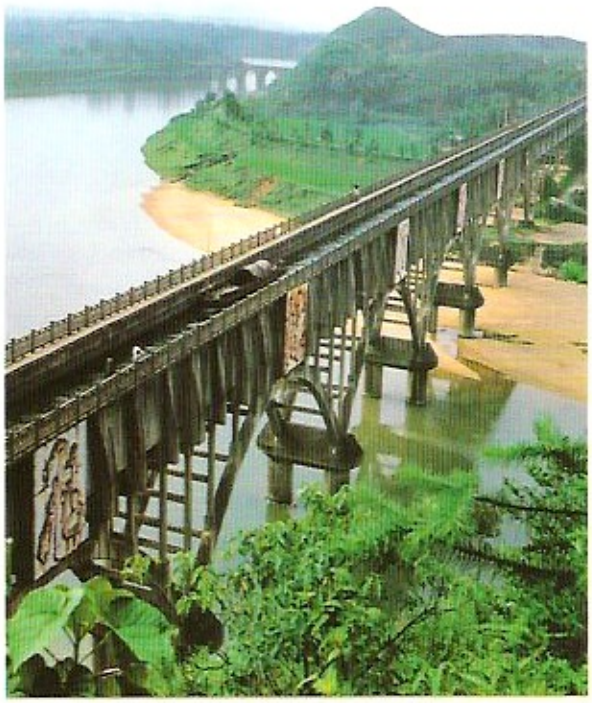
With regard to the new developments and problems in water work, China shall take well-targeted measures to speed up innovation in water science and technology in line with the new requirements of socioeconomic development. Greater importance will be attached to the following areas: (1) research on the impacts of global climate change and large-scale human activities on water resources in China and the countermeasures thereof; (2) research on the strategies and countermeasures to solve problems such as drought & water shortage, flood & logging, water pollution and soil erosion; (3) integration and combination of engineering technology, natural science and social science in water work; (4) promotion, commercialization and application of research results in water science and technology; and (5) application of new and high technologies in the water sector, so as to strive for new technological breakthroughs and achievements in major areas and key points of water-related work.

"Theory and Practice of Water and Sediment Regulation of the Yellow River" won the first prize of National Scientific and Technological Progress in 2010

2. Strateg and Measures for Future Development

2.1 Strategy for Future Development

For future development of water science and technology, the water sector will follow the guiding principle of the central government on science and technology, namely, "indigenous innovation, leapfrog advances, support to development and guidance for the future", and uphold the principle of water management for the new era, i.e., "prioritizing water saving, spatial balance, systematic governance, and equal attention to conservation and development". To address the four major pressing water issues in China, i.e., shortage of water, soil erosion, flood and drought, and severe water pollution, we will strengthen top-level design, promote optimal allocation of scientific and technological resources, establish and improve



The aqueduct in Shaoshan Irrigation District of Hunan Province

the innovation system for science and technology, work hard to eliminate the significant technical barriers in the development of water conservancy, boost technological introduction, and enhance the promotion and industrial application of scientific and technological advances, thereby providing support and guarantee for sustainable development of water conservancy.

Research efforts will focus on the following eight priority areas:

2.1.1 Hydrological and Hydraulic Resources

Research in this area will cover (1) the scientific foundation for and technological solution to the "Three Red Lines" under the most strict management of water resources, i. e., red lines for water development and utilization control, water use efficiency control,

Ecological water system for the Oylimpic Park

and pollutant load control in water function zones; (2) evolution mechanism and control methodology for the water cycle and its associated process in the changing environment; (3) systematic layout, rational distribution and optimal regulation of water system linkage between rivers and lakes; (4) key technologies for integrated utilization of surface water, ground water and non-conventional water resources; (5) key technologies for monitoring, protecting and utilizing ground water; and (6) key technologies for the development and utilization of water resources in trans-boundary rivers.

2.1.2 Flood Control, Drought Relief and Disaster Mitigation

Research in this area will cover (1) emergency response technologies and mechanisms for extraordinary floods along major rivers; (2) key technologies for flood control in small and medium rivers and prevention of extreme flush flood disasters; (3) evolution rules as well as risk assessment theories and methods for large-scale long-duration droughts; (4) key technologies for forecasting, early warning and risk assessment of storm tides; (5) key technologies for the prevention and control of urban floods; and (6) emergency response management mechanisms and countermeasures for significant water emergencies.

2.1.3 Water Environment and Water Ecology

Research in this area will cover (1) key technologies for the assessment, regulation and control of environmental and ecological impacts of major water works; (2) framework of assessment technologies and assessment standards regarding health status of rivers and lakes; (3) all-round mechanisms and key technologies for safeguarding the safety of drinking water sources; (4) key technologies for comprehensive governance of urban water environment; and (5) technologies for large-scale protection of water resources and restoration of water ecosystem.

2.1.4 Construction and Management of Water Works

Research in this area will cover (1) security diagnosis, evaluation and restoration technologies for large water works; (2) key technologies for the construction and

safe operation of large water diversion works; (3) key technologies for the construction of high dams with a height of at least 300 meters; (4) key technologies for the construction and protection of water works in high-altitude, permafrost and earthquake-prone areas; (5) key technologies for emergency response and restoration of water works in case of material security incidents; and (6) new materials and new technologies to be used in security diagnosis and reinforcement of medium and small sized reservoirs, sluice gates and dykes.,

2.1.5 Rural Water Conservancy Works

Research in this area will cover (1) key technologies for highly-efficient use of water resources in major grain production areas; (2) technologies and devices for improving agricultural water use efficiency; (3) key technologies for safeguarding safety of drinking water in rural and pastoral areas; (4) key technologies for development and utilization of environment-friendly small hydropower works in rural areas; and (5) technologies for safeguarding safety of drinking water in hilly areas and on sea islands.

2.1.6 Governance of Rivers and Lakes

Research in this area will cover (1) key technologies for regulating and controlling water and sediment, and for turning sediment into a resource; (2) river-lake relation in the middle reach of the Yangtze River and technologies for the distribution of water resources and water regulation for flood control purpose; (3) technologies for comprehensive governance of small and medium rivers; and (4) key technologies for dredging of rivers and lakes, and disposal and utilization of silt.

2.1.7 Soil and Water Conservation

Research in this area will cover (1) causal relation between water and soil conservation and river

Linhuaigang Flood Control Project

Water and soil conservation garden in Longli of Guizhou Province

sedimentation and its evolution mechanism; (2) technologies for restoring vegetation in ecologically fragile areas; (3) monitoring, diagnosis and assessment technologies for water and soil erosion;
(4) comprehensive governance of small watersheds; and (5) technologies for integrated control of soil erosion and highly efficient utilization of slope farmland.

2.2 Main Measures

The following measures shall be adopted in line with the strategy for future development:
(1) Enhance leadership and collaboration;
(2) Deepen restructuring of water science and technology;
(3) Invest more in science and technology with the use of multiple financing channels;
(4) Speed up platform development for scientific and technological innovation;
(5) Render more support to the training and cultivation of talents in science and technology

3. International Cooperation and Exchanges

Hitherto, the PRC Ministry of Water Resources (MWR) has established cooperative relations with more than 60 countries and regions, and concluded 68 agreements or memorandums of understanding on water cooperation. Such continuous expansion efforts have given rise to a layout of holistic, multi-layer and wide-coverage international cooperation and exchanges in water resources. China has implemented a group of key international cooperation projects in science and technology to improve capacity building of the water sector, including, among others, the Flood Management Program in Songhua River financed by Asian Development Bank loans, the Sino-Australian Partnership Program for Environment Development, and the EU-China Integrated River Basin Management Project. China has also successfully hosted a series of major international water events, such as the Congress of the International Commission on Large Dams, World Congress of the International Association for Hydro-Environment Engineering and Research (IAHR) , Congress of the International Commission on Irrigation and Drainage (ICID), and Meeting of the United Nations Secretary-General's Advisory Board on Water and Sanitation, etc. Other famous water events, including the Yellow River Forum and the Yangtze River Forum, have also enhanced China's international influence. Over the recent years, some outstanding Chinese water experts have held important positions in key water-related international organizations. For instance, the International Commission on Large Dams ("ICOLD"), the International Commission on Irrigation and Drainage ("ICID"), the International Seabuckthorn Association ("ISA"), the International Network on Small Hydro Power ("IN-SHP"), and the International Water Resources Association ("IWRA") were once or are still chaired by Chinese experts. In addition, by pioneering into international markets, China has continuously expanded its exports of such advanced technologies and devices as electromechanical

Mr. Chen Lei, Minister of Water Resources, signed a MOU with Mr. Loïc Fauchon, President of World Water Council

The Chinese delegation attending the 2nd MRC Summit

devices for hydro power stations, small hydro power equipment and rainwater harvesting and utilization facilities, and increased its outbound technical consulting services.

In the research of water science and technology, we will closely follow frontline issues and topical issues in the international arena, broaden the fields of international cooperation and exchanges, and intensify our participation in international activities. First, we will actively introduce state-of-the-art overseas technologies and practices, advanced experiences, talented personnel and R&D funds into China to speed up innovation in water science and technology. Second, we will continue to support and encourage the exporting of water technologies and products with our own intellectual property rights, intensify cooperation and exchanges between research institutions at home and abroad, and support resourceful and internationally competitive research institutions, universities and enterprises to go global. Third, we will invite foreign experts with pertinent expertise to work or conduct academic exchanges in China, and encourage Chinese water experts to play a bigger role in international water events.

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