

Belt and Road Water Science and Technology Cooperation: Opportunities and Challenges (Post-print)

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Date: 2017-11-05T00:00:00+00:00

Abstract

[Purpose/Significance] The Belt and Road Initiative has catalyzed multi-dimensional cooperation and exchanges between China and participating countries. Addressing the urgent needs of these countries in water technology and leveraging China's substantial accumulated capabilities in relevant fields in recent years, this study explores a government-industry-academia-research cooperation mechanism with science and technology as the platform. This approach aims to assist participating countries in coping with water security challenges while simultaneously promoting the international expansion of China's water technology industry, thereby establishing a mutually beneficial cooperation model. [Methods/Process] This paper analyzes the fundamental conditions of Belt and Road countries, identifies the challenges they confront in the water technology sector, and shares the progress and achievements of the CAS-TWAS Centre of Excellence for Water and Environment (CEWE) in its exchanges and cooperation with these countries. [Results/Conclusions] CAS-TWAS CEWE actively explores government-industry-academia-research cooperation mechanisms and has established a trinity model of "talent cultivation—scientific and technological assistance—enterprise follow-up." While assisting participating countries in enhancing their water technology innovation capabilities, it actively creates conditions and opportunities for Chinese water technology enterprises to expand internationally, initially fostering a favorable situation where "scientific and technological assistance and economic returns" mutually reinforce each other, thereby enhancing China's international image in green diplomacy.

Full Text

Opportunities and Challenges in Water Science and Technology Cooperation Between China and the Countries along the Belt and Road

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Abstract

[Purpose/Significance] The Belt and Road Initiative has fostered multi-faceted cooperation and exchanges between China and participating countries. Building upon China's substantial capabilities in water science and technology, this paper explores a government-industry-academia-research collaboration mechanism that uses science and technology as a platform to address urgent water security challenges in partner nations while promoting the international expansion of China's water technology industry, thereby establishing a mutually beneficial cooperation model. **[Method/Process]** This paper analyzes the fundamental conditions of countries along the Belt and Road, identifies their challenges in water science and technology, and shares progress and achievements from the CAS-TWAS Centre of Excellence for Water and Environment (CEWE) in its exchanges and cooperation with these nations. **[Result/Conclusion]** CAS-TWAS CEWE has actively explored a government-industry-academia-research collaboration mechanism, creating a trinity model of "talent cultivation-technical assistance-enterprise follow-up." While helping partner countries enhance their water science and technology innovation capacity, CEWE creates conditions and opportunities for Chinese water enterprises to expand internationally, initially forming a virtuous cycle where "technical assistance and economic returns" reinforce each other and elevating China's international image through green diplomacy.

Keywords: Belt and Road; water science and technology; water resources; cooperation

The Belt and Road construction is a systematic engineering endeavor. The Chinese government has formulated and released the "Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road," advancing the implementation of this major initiative to rejuvenate the ancient Silk Road with new vitality and strengthen connections among Asian, European, and African countries through new forms of mutually beneficial cooperation reaching new historical heights. Developing countries along the route have weak capabilities in drinking water safety assurance and water environmental protection, with health hazards from unsafe drinking water being particularly

prominent. These nations face severe challenges in achieving the UN Millennium Development Goal of “halving, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation.” In response, the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, has aligned with the national Belt and Road Initiative and the CAS “Pioneer Initiative,” integrating resources from relevant CAS institutes, government ministries, water utilities, and investment companies to construct a trinity platform and support system of “talent cultivation–technical assistance–enterprise participation.” This initiative aims to enhance drinking water safety assurance capabilities in partner countries to address critical livelihood issues while promoting the export of China’s water industry technology and capital, achieving a win-win situation of “problem-solving and economic returns” and creating a new image of “clean water diplomacy.”

Since 2012, leveraging the 23rd General Conference of The World Academy of Sciences (TWAS) as an opportunity and with strong support from relevant ministries, the Chinese Academy of Sciences has conducted a series of science and technology cooperation initiatives with developing countries in areas such as scientific innovation, strategic consulting, and capacity building, yielding remarkable results. These actions directly and effectively serve the implementation of the national Belt and Road Initiative and have laid a solid foundation for supporting Belt and Road construction and jointly addressing common scientific challenges.

Since 2013, the Chinese Academy of Sciences has pioneered the establishment of a Belt and Road science and technology cooperation system combining “talent, platform, and project,” successively launching the “Developing Countries Science and Education Cooperation Expansion Project” and the Belt and Road Science and Technology Cooperation Action Plan. This includes establishing overseas science and education bases in developing countries, setting up CAS-TWAS Centers of Excellence in various fields, establishing CAS-TWAS Presidential Fellowships, and deploying a batch of Belt and Road science and technology cooperation cultivation projects, making it the earliest Chinese institution to conduct systematic and substantive international science and technology cooperation around the Belt and Road Initiative.

Currently, the scale of science and technology exchanges and cooperation between the Chinese Academy of Sciences and Belt and Road countries (regions) exceeds 20,000 person-times annually, with nearly 300 outstanding scientific and technological talents introduced and over 600 doctoral students from Belt and Road countries funded, covering almost all disciplines of CAS. Additionally, CAS has built seven overseas science and education bases in Belt and Road countries (regions), established and operates five CAS-TWAS Centers of Excellence, conducted extensive South-South science and technology cooperation, effectively promoted North-South cooperation, with a cumulative investment exceeding 7 billion RMB.

The CAS-TWAS Centers of Excellence are deployed in areas of common concern

to developing countries, including climate change and environment, drinking water safety, biotechnology, green energy technology, and disaster prevention and mitigation. They actively play a platform role, create a number of international brand conferences, produce influential professional consulting reports, train nearly 1,000 scientific and technological talents from Belt and Road countries, cultivate extensive human resources, establish good cooperative and mutual trust relationships, and form an integrated platform with overseas science and education bases that “echo each other internally and externally with orderly coordination.”

2.1 Development of China’ s Water Science and Technology

To achieve sound and rapid economic and social development, adjust economic structure, transform growth mode, and alleviate bottlenecks in energy, resources, and environment, China has made substantial investments in water pollution control and management, successively launching major projects such as the Water Special Project and policies like the Water Ten Points.

In terms of science and technology, the Water Special Project is one of the sixteen major projects listed in the “National Medium- and Long-term Science and Technology Development Plan Outline (2006-2020).” Since its implementation, the project has invested over 10 billion RMB, breaking through more than 1,000 key technologies in water pollution control, water environment management, and drinking water safety assurance. It has constructed over 500 technology demonstration projects, authorized more than 1,400 domestic and foreign patents, built over 300 industry-academia-research development platforms and bases, established eight industrial technology innovation strategic alliances serving hundreds of enterprises, and generated nearly 8 billion RMB in cumulative output value, providing comprehensive support for the implementation of national strategies such as the Water Pollution Prevention and Control Action Plan and sponge city construction.

In April 2015, the State Council officially released the “Water Pollution Prevention and Control Action Plan” (commonly known as Water Ten Points), with an estimated total investment of 4-5 trillion RMB, of which local government investment will reach 1.5 trillion RMB. The Ministry of Environmental Protection used internationally accepted models to predict and evaluate the impact of Water Ten Points, estimating it could drive GDP growth of approximately 5.7 trillion RMB, with direct contributions accounting for 13% and indirect contributions for 87%. Through increased pollution control investment and substantial enhancement of pollution control technology, environmental protection equipment development, and industrialization levels, Water Ten Points will drive approximately 1.9 trillion RMB in new output value for the environmental protection industry, including about 1.4 trillion RMB in direct purchases of environmental products and services, making the environmental protection industry a new economic growth point.

Scientific and technological innovation plays an important pioneering role in Belt and Road construction. Compared with countries along the route, China has achieved numerous accomplishments in water science and technology development, forming certain technological advantages that help elevate the level of international cooperation, leverage scientific and technological innovation strengths, and transform traditional industrial “advantageous capacity” cooperation into “new capacity” cooperation in science and technology.

The Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, has long been committed to applied basic research, key technology development, and engineering applications in drinking water safety assurance, achieving a series of innovative results and successfully applying them domestically. The center has formed a complete technical system from “water source to tap,” with particular focus on new technology development and industrialization. Major achievements include: (1) Water source pollution control and water quality improvement technologies. The center developed online biological early warning equipment for sudden pollution incidents, successfully applied to water quality monitoring in Miyun Reservoir and Jingmi Diversion Canal. To address urgent needs for improving micro-polluted source water quality, it developed large-scale water source restoration technology, successfully applied to the Shijiyang Water Supply Project in Jiaxing, Zhejiang (treating 240,000 tons of source water daily with 600,000 tons of water storage capacity), which won the UN-Habitat “Global 100 Best Practices” award in 2012. (2) Efficient drinking water purification technologies for water treatment plants. To meet arsenic removal needs at different scales—from household purifiers to rural decentralized stations to urban water plants—the center developed composite metal oxide drinking water high-efficiency arsenic removal technology, successfully applied to large-scale water plant renovation projects such as the Louzizhuang arsenic removal plant in Chaoyang District, Beijing (Phase I: 5,000 tons/day; Phase II: 20,000 tons/day) and the Zhengzhou Dongzhou Water Plant strengthening renovation project (200,000 tons/day), as well as over ten rural decentralized water supply projects in Changping and Shunyi districts. Fluoride removal technology has been demonstrated in a 25,000 tons/day project in Inner Mongolia. (3) Safe drinking water distribution and end-point risk control technologies. The center developed urban water supply network monitoring, early warning, and control systems, applied to daily leak detection work of the Beijing Waterworks Group, making important contributions to drinking water safety assurance in the capital.

2.2 Water Needs of Countries along the Belt and Road

Safe and sanitary water is one of the basic conditions for human survival. Developing countries generally face serious drinking water safety issues, with severe challenges in achieving the UN Millennium Development Goal of halving the proportion of the population without sustainable access to safe drinking water and basic sanitation. According to the UN World Water Development Report,

884 million people worldwide still use unimproved drinking water sources, 2.6 billion people lack improved sanitation facilities, and approximately 3-4 billion people do not have safe and reliable tap water at home. About 3.5 million deaths annually are related to insufficient water supply and poor sanitation conditions, primarily in developing countries. Improving water safety, sanitation facilities, and hygiene conditions could save 2.2 million children from dying each year.

Countries along the Belt and Road generally face drinking water safety assurance problems that have become increasingly severe due to rapid socio-economic development. These challenges manifest in three main aspects: (1) Relatively backward management levels. Standards are directly copied from Europe and America without adaptation or implementation capacity; effective monitoring equipment is lacking; collection of various monitoring data and acquisition and sharing of basic data need strengthening; water supply and drainage management systems are inadequate; infrastructure is incomplete; and system construction lacks funding. (2) Water quality-induced scarcity due to pollution. Drinking water sources are severely polluted, with effective purification measures lacking. In areas using groundwater, problems such as arsenic, fluoride, hardness, and pathogenic microorganism contamination cause serious waterborne diseases (including dental fluorosis, cholera, dysentery, typhoid, and chronic kidney disease). (3) Low technological levels, lack of talent reserves, low industrialization levels, and seriously insufficient product supporting capabilities.

3.1 Cooperation Approach

Addressing the widespread drinking water safety issues and needs in Southeast and South Asian countries, the Chinese Academy of Sciences is actively developing this livelihood project benefiting over one billion people. This initiative not only demonstrates China's "amity, sincerity, mutual benefit, and inclusiveness" diplomatic spirit toward neighboring countries but also has the potential to open up enormous markets. For instance, the Research Center for Eco-Environmental Sciences has a strong foundation in drinking water safety assurance, rural sewage treatment, and industrial wastewater treatment; the Institute of Remote Sensing can provide decision support system services for integrated water resources management; the Institute of Hydrobiology has distinctive features in ecological restoration and protection; and the Hefei Institute of Intelligent Machines has developed fluoride removal nanomaterials and related products. If these technologies and products can be combined with the strong capital operation and industrialization capabilities of Chinese water enterprises and demonstrated and promoted through the science and technology joint center platform, they can be extended to South and Southeast Asia in the future.

Therefore, aligning with the national Belt and Road Initiative and the CAS Pioneer Action Plan, and integrating relevant CAS institutes, ministries, water utilities, and investment companies, we aim to build a trinity platform and support system of "talent cultivation-technical assistance-enterprise participation." While helping partner countries enhance drinking water safety assurance capa-

bilities and solve critical livelihood issues, this initiative effectively promotes the export of China's water industry technology and capital, achieves a win-win situation of "problem-solving and economic returns," creates a new situation of "clean water diplomacy," and significantly enhances China's national image in surrounding regions. Simultaneously, such institute-enterprise cooperation strengthens collaboration between CAS and enterprises, playing a positive role in upgrading China's industrial technology levels.

3.1.1 Building a Trinity Platform and Support System of "Talent Cultivation-Technical Assistance-Enterprise Participation" Addressing the drinking water safety needs of developing countries along the Belt and Road, particularly the current lack of water supply and drainage talent reserves, the CAS-TWAS Centre of Excellence for Water and Environment (CEWE) at the Research Center for Eco-Environmental Sciences, in conjunction with bilateral or multilateral agreements signed between China and developing countries, has constructed a trinity platform and support system of "talent cultivation-technical assistance-enterprise participation." Using talent cultivation as the entry point, CEWE has established various talent training programs (training courses, master's/doctoral students, postdoctoral fellows) to cultivate high-level management and technical talents in water and environmental fields for developing countries. Through technology transfer and joint research, CEWE develops economically applicable technologies and provides comprehensive solutions to water and environmental problems for developing countries along the route, establishing a platform for water and environmental technology exchange, cooperation, and achievement transformation.

3.1.2 Conducting Basic Surveys and Policy Research on Water Supply and Drainage in South and Southeast Asian Countries Given the inadequate water supply and drainage management systems and relatively low management levels in developing countries, CEWE actively conducts basic surveys and policy research on water supply and drainage in South and Southeast Asian countries through cooperation and in conjunction with relevant ministries, helping them improve management systems and enhance management levels.

3.1.3 Promoting Technology Export and Transfer of the Water Industry to Create a New Situation of "Clean Water Diplomacy" Since drinking water safety issues in developing countries ultimately require solutions from the water industry, CEWE integrates relevant CAS water technology institutes, water utilities, investment companies, and government departments to promote technology and product export and transfer of the water industry according to the needs of the national Belt and Road Initiative, thereby achieving a win-win situation of "problem-solving and economic returns."

3.2 Progress

Science and technology assistance is an important component of China's foreign aid. In recent years, relying on CAS-TWAS CEWE, the Research Center for Eco-Environmental Sciences has carried out effective work in "water and sanitation training for developing countries," training nearly 100 participants from over 30 countries, expanding its scientific and technological influence in developing countries, and promoting scientific and technological exchange and cooperation.

Guided by the trinity science and technology assistance model of "talent cultivation-technical assistance-enterprise follow-up," CAS-TWAS CEWE has conducted work around "water and sanitation in developing countries." While helping these countries improve drinking water and water environment safety assurance capabilities, CEWE has established China's international image in green diplomacy and promoted the export of China's water industry technology and capital, initially forming a virtuous cycle where technical assistance and economic returns reinforce each other.

3.2.1 Developing Multi-level Talent Training Programs, Enlisting Industry Experts to Enrich the Lecturer Team, and Establishing Student Reporting and Tracking Mechanisms to Create Conditions for Science and Technology Cooperation

CEWE organizes one long-term and one short-term training course annually. All participants are required to conduct thorough research on their country's current water and sanitation status and challenges before coming to China and deliver presentations introducing their country's water sources, water supply and drainage conditions, government functions, and operational and management difficulties. Based on this foundation, they participate in learning and discussions. CEWE collects water and sanitation information from various countries through participant exchanges, conducts questionnaire surveys to comprehensively understand participant backgrounds, identifies and focuses on actual needs in their countries, and designs targeted courses and support work with remarkable overall effectiveness. The training program has evolved from a 10-day intensive short-term course in 2013 to a two-month training in 2014 (adding research internships in laboratory groups based on participants' work and research directions), and then to a combination of short-term (two weeks/14 days) and long-term (87 days/nearly three months) training in 2015, forming a relatively complete and distinctive curriculum and model with greater depth and significant improvement in participants' capabilities. The lecturer team includes not only scientific experts from universities and CAS institutes but also leaders and experts from environmental protection, construction, and health departments, water supply and drainage industry experts, and internationally renowned scholars, creating a strong faculty with rich course content. The training adopts various forms including intensive lectures, technical inspections, thematic discussions, and enterprise visits, enabling participants to comprehensively understand China's water environment governance status and industrial support capabilities. In 2015, the IWA (International Wa-

ter Association) Asia-Pacific Regional Conference and Exhibition was incorporated as a training platform, leading participants from developing countries to understand global water treatment and management technologies. Over three years, the training courses have trained more than 100 participants from over 30 countries, primarily recruiting management personnel from government departments, research institutes, and water utilities with good qualifications and high levels, facilitating broader and longer-term cooperative relationships with developing countries. CEWE emphasizes interactive communication and information feedback with participants, providing a solid foundation and favorable conditions for future science and technology cooperation and project implementation in Sri Lanka, Cambodia, Nepal, Africa, and other countries. In 2016, over 400 applications were received, demonstrating expanding and increasing influence in developing countries year by year. Additionally, CEWE cooperates with the Cambodia Water Association to actively promote overseas training, holding a water plant technology training course in Phnom Penh in 2015 that attracted more than 30 water plant management and technical personnel, creating significant impact. The training courses have become a window for participants to gain in-depth understanding of CAS, with an increasing number of outstanding overseas youth applying for doctoral and postdoctoral programs at the Research Center for Eco-Environmental Sciences, substantially increasing the number of international students and overseas postdoctoral researchers in recent years. CEWE has also established a working mechanism for communication with international students and overseas postdoctoral researchers at the institute.

3.2.2 Addressing Major Livelihood Needs of Recipient Countries, Cultivating and Identifying Current and Future Major Programs and Projects, and Establishing a Government-Industry-Academia-Research Collaborative Promotion Mechanism CEWE has focused on Sri Lanka's serious health challenges from Chronic Kidney Disease of Unknown etiology (CKDu) and related drinking water safety issues. Through in-depth exchanges with Sri Lanka's Ministry of Water Supply and Drainage and the National Water Supply and Drainage Board, and based on field investigations in CKDu-affected areas, CEWE facilitated the signing of a memorandum of cooperation between the Chinese Academy of Sciences and Sri Lanka's Ministry of Water Supply and Drainage under the witness of both heads of state. Simultaneously, the Research Center for Eco-Environmental Sciences signed a cooperation agreement with Sri Lanka's National Water Supply and Drainage Board to implement the intergovernmental memorandum, with related cooperation projects included in China's Ministry of Commerce foreign aid funding plan. On March 26, 2015, under the witness of President Xi Jinping and President Sirisena, CAS President Bai Chunli and Sri Lankan Minister of Urban Development and Water Supply Rauff Hakeem signed the "Memorandum of Cooperation between the Chinese Academy of Sciences and the Ministry of Urban Development and Water Supply of Sri Lanka" at the

Great Hall of the People. On June 26 of the same year, Yang Min, Deputy Director of the Research Center for Eco-Environmental Sciences and Director of CEWE, and S. Rajabdeen, Vice Chairman of Sri Lanka's National Water Supply and Drainage Board, signed the "Memorandum of Cooperation between the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences and the National Water Supply and Drainage Board of Sri Lanka," formally establishing bilateral cooperative relations.

On April 7, 2016, under the witness of Premier Li Keqiang and Sri Lankan Prime Minister Ranil Wickremesinghe, NSFC Director Yang Wei and Sri Lankan National Science Foundation (NSF) Chairperson Professor Sirimali Fernando signed the "NSFC-NSF Science and Technology Cooperation Memorandum of Understanding" at the Great Hall of the People, creating favorable conditions for cooperation and exchanges between scientists of both countries. From February 22-27, CEWE invited a senior Sri Lankan delegation including Professor Fernando, facilitating meetings between leaders of the two foundations' leadership and laying a good foundation for signing the bilateral agreement. Under the intergovernmental agreement, CAS and Sri Lanka will jointly establish the "China-Sri Lanka Water Technology Research and Demonstration Joint Center" in Kandy.

On March 15, 2016, the Joint Seminar on Chronic Kidney Disease of Unknown Etiology (CKDu), co-hosted by the Chinese Academy of Sciences and Sri Lanka's Ministry of Urban Planning and Water Supply, was successfully held in Colombo. More than 150 experts from both countries attended, including specialists in public health, environmental science, drinking water, hydrogeology, and chronic kidney disease from the Research Center for Eco-Environmental Sciences, Peking University and its First Affiliated Hospital, Beijing Center for Disease Control and Prevention, NSFC, Sri Lanka's Presidential Task Force on CKDu, Ministry of Health, University of Peradeniya, and University of Sri Jayewardenepura. Experts from both sides conducted comprehensive discussions on possible causes and solutions for CKDu related to water quality, geochemistry, agricultural practices, diet, medical care, and social factors, and jointly formulated the "Recommendations for CKDu Mitigation Action Plan" focusing on prevention, treatment, control, and etiological research.

Focusing on Sri Lanka's safe water supply issues, CEWE conducts technology research and demonstration. Taking Sri Lanka's dry zone as a demonstration area and based on existing water quality data analysis, multiple rounds of field investigations, bilateral technical exchanges, and expert demonstrations, several typical treatment processes have been preliminarily selected for establishment, including membrane technology (nanofiltration), hardness and nitrate removal, rainwater collection and utilization, and treatment technologies for high-hardness, high-fluoride, and high-nitrate water. In cooperation with several Chinese water enterprises, multi-parameter water quality analyzers for water plants, hardness removal technologies, and rainwater collection equipment are under intensive development. CEWE has organized experts from Beijing CDC,

Peking University and its First Affiliated Hospital, and relevant institute experts to investigate domestic and international CKDu research literature, summarize Sri Lanka's CKDu characteristics and related research from perspectives of definition, etiology, and solutions, and propose relevant ideas for CKDu etiological research. Based on multiple communications with relevant experts, the "Research Plan for Etiology of Chronic Kidney Disease of Unknown Etiology in Sri Lanka" has been proposed, including four research directions: verifying Sri Lanka's CKDu diagnostic criteria, establishing and improving Sri Lanka's CKDu monitoring system, conducting environmental monitoring and dietary survey research, and exploring CKDu etiology and developing early screening tools. As important support for the above scientific research, establishing the Beidou monitoring and management platform for water stations in Sri Lanka's dry zone will play a crucial role. According to Sri Lanka's current situation, a three-level water station monitoring and management system platform has been designed: (1) a national-level top design platform located at the Ministry of Water Supply and Drainage in Colombo; (2) regional-level platforms, currently planned for two locations in Kandy and Anuradhapura; and (3) village-level residential drinking water stations based on existing stations with appropriate additions according to local needs, with the first-phase demonstration totaling ten stations.

Beyond cooperation with Sri Lanka, CEWE has established connections with Cambodia, Bangladesh, and Nepal, laying out a comprehensive network along the Belt and Road route. In Cambodia, inter-institutional agreements have been signed to strengthen water and environmental cooperation, explore government-industry-academia-research collaboration models, and launch overseas training to provide technical guidance and solve problems locally, creating significant impact. In Bangladesh, enterprises pave the way for cooperation with CEWE providing technical follow-up, dedicated to solving the world's difficult problem of arsenic removal from groundwater. In Nepal, drinking water equipment was donated after the earthquake to help solve drinking water safety assurance issues. Meanwhile, cooperation pathways with Africa are being explored. Using successive water and sanitation training courses as a platform, CEWE has consistently worked through African participants to conduct in-depth investigations of local water and sanitation conditions and arranged African participants for internships in research groups. Currently, CEWE has collected abundant data on African water quality and sanitation, organized a report compilation committee including Chinese and African personnel, integrated existing information and data, and compiled investigation reports on African water quality conditions for publication.

3.2.3 Establishing the "Belt and Road Water Science and Technology and Industry Alliance" and Creating an Integrated Mechanism for International Cooperation and Institute-Locality Cooperation CEWE's water technology cooperation with developing countries focuses on livelihood issues, centering on the Belt and Road Initiative and CAS's Pioneer Action Plan.

By fully utilizing scientific and technological forces both within and outside CAS, CEWE leads brother institutes including the Institute of Hydrobiology, Institute of Intelligent Machines, Institute of Remote Sensing, and Xinjiang Institute, as well as numerous water enterprises such as Lihua Technology, MCC International, and Taining, to prepare and build the “Belt and Road Water Science and Technology and Industry Alliance,” creating an innovative integrated mechanism for international cooperation and institute-locality cooperation. The alliance’ s purposes are: (1) to provide targeted solutions and technical support for developing countries and accelerate the export of China’ s water industry to developing countries for market promotion and application abroad; (2) to organize alliance members to conduct business inspections and negotiations with developing countries and carry out technical exchanges and cooperation, as well as organize and participate in relevant domestic and international conferences on water and environmental cooperation; (3) to assist in arranging visits, training, and internships for water and environmental representatives (delegations) from developing countries and organize communication between representative domestic enterprises and developing country representatives; (4) to provide services for alliance enterprises, submit relevant investigation and consulting reports to government departments, research and develop strategies for going global, and provide reference opinions and consulting for enterprises; and (5) to organize the formulation of water and engineering standards for developing countries and conduct training and guidance on relevant laws and customs. The alliance will be developed into a learning and exchange center for “going global” enterprises, thereby facilitating the implementation of enterprise technology and products and achieving market promotion and application abroad. This not only ensures the in-depth development of cooperation projects and significantly enhances CAS’ s international image in terms of national strategy and international scientific and technological strength but also promotes scientific and technological innovation and achievement transformation in broader fields, driving Chinese water enterprises and independent intellectual property rights onto the international stage.

MCC International Engineering Group Co., Ltd. cooperates with CEWE on drinking water arsenic removal technology to solve arsenic pollution problems in rural Bangladesh. In November 2015, CEWE and MCC organized a joint delegation to visit Bangladesh, held in-depth discussions with the Department of Public Health Engineering (DPHE) on advancing the roadmap and details for implementing the arsenic removal assistance project, and introduced the arsenic removal technology principles, application models, technical advantages, and engineering cases in detail to the Chairman of the Bangladesh Council of Scientific and Industrial Research (BCSIR), technical certification officials, and other Bangladeshi arsenic removal advisors and technical experts. The BCSIR Chairman fully affirmed CEWE’ s work in basic research and technology development, expressed full support and cooperation for completing official technical certification in Bangladesh to obtain local legal application qualification, and hoped to sign an MoU with CEWE to cooperate in drinking water and compre-

hensive water environment management, providing systematic technical support for Bangladesh's drinking water and water environment safety. Meanwhile, the Chinese Embassy in Bangladesh expressed full support for the project.

4.1 Establishing a Belt and Road Water Science and Technology Cooperation Special Program

Using science and technology to lead and support Belt and Road construction is a complex systematic project that requires strengthened top-level design. According to the principle of “adhering to market operation: following market laws and international common rules, and giving full play to the decisive role of the market in resource allocation and the principal role of various enterprises,” it must be actively promoted with focus and planning. It is recommended that, according to relevant requirements in the top-level Belt and Road design, science and technology resources and needs between China and Belt and Road countries be thoroughly reviewed, and government departments, research institutions, enterprises, and experts jointly formulate a special plan for science and technology leading and supporting the Belt and Road Initiative.

4.2 Strengthening International Water Science and Technology Cooperation and Mechanism Innovation

Current international cooperation systems and mechanisms are mainly formulated around academic exchanges and cooperation with developed countries, with many management regulations unsuitable for assistance cooperation with developing countries, affecting work enthusiasm and efficiency. The state needs to strengthen communication with various government departments, formulate work systems and mechanisms suitable for cooperation with developing countries according to their actual needs and conditions, ensure personnel safety and work efficiency, build inter-departmental consultation mechanisms, and establish bilateral-based, multilateral-supplemented exchange mechanisms. By fully leveraging the role of existing committees and other bodies, a united front for foreign assistance should be built to significantly enhance foreign aid benefits. Domestic water-related departments should systematically engage with relevant departments in partner countries under a certain framework to coordinate and promote project implementation.

4.3 Establishing a Belt and Road Talent Cultivation System

Talent is the fulcrum and key to Belt and Road construction and the most dynamic resource in science and technology cooperation activities. Gathering international excellent talents is crucial for international science and technology cooperation. During Belt and Road construction, it is necessary to enhance the educational soft power of partner countries, build a comprehensive and multi-level talent cultivation and education system, and train international scientific and technological talents, international organization management talents, and high-end talents, using talents to drive projects and projects to gather talents.

4.4 Promoting Water Enterprise Participation in Belt and Road Construction

Enterprises are the most dynamic economic entities, and enterprise innovation capability is a concrete manifestation of scientific and technological innovation capability. Promoting water enterprise participation in Belt and Road construction and enhancing enterprise innovation capability is significant for promoting the close integration of science and technology with economy, deepening scientific and technological opening and cooperation, and improving the internationalization level of scientific and technological development. By leveraging Belt and Road development to open new paths for international science and technology cooperation, promoting the establishment of new mechanisms for collaborative innovation and cooperation among water enterprises, and combining relevant policy measures with science and technology as a platform, technical cooperation and collaborative innovation can be strengthened to enhance enterprises' independent innovation capability, stimulate enterprise vitality, and closely integrate with local water needs and governments and enterprises in partner countries.

4.5 CEWE Next Work Plan

In foreign assistance cooperation, China-Sri Lanka cooperation will comprehensively carry out etiological investigation of CKDu and research and development of drinking water safety assurance technologies, fully coordinate with the implementation of the China-Sri Lanka Joint Research Center building project, and provide a batch of training for the Sri Lankan government. China-Bangladesh cooperation will be comprehensively promoted, striving for breakthroughs in the demonstration and application of arsenic removal engineering technology. For Africa, cooperation pathways will be explored relying on the China-Africa Center.

Regarding training, overseas training will be combined with domestic training. Domestic training will continue to include both long-term and short-term training courses for participants. In Belt and Road project construction, operation management will be optimized, cooperation mechanisms will be established with relevant domestic and international institutions, cooperation with developing countries will be deepened, and resources will be integrated with complementary advantages. Internal management systems will be improved, team building strengthened, and training effect evaluation and follow-up work enhanced. Website construction and data organization will be improved, publicity levels elevated, more international recognition obtained, and international visibility in water science and technology further enhanced.

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Note: Figure translations are in progress. See original paper for figures.

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