

# SHP



# NEWS

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In 2021, HRC seriously studied and earnestly implemented Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, and the spirit of the Sixth Plenary Session of the 19<sup>th</sup> CPC Central Committee. Based on an accurate understanding of the new stage of development, with a view to fully implementing the new development philosophy and accelerating our efforts to create a new development dynamic, and led by the Ministry of Water Resources (MWR) of the People's Republic of China and Nanjing Hydraulic Research Institute (NHRI), HRC spared no efforts in 2021 to overcome the impact of the pandemic, innovate the China-aid training models, conduct the international trainings and seminars, continuously promote the overseas technology transfer centers and extensively open up overseas markets, which have yielded fruitful results in all respects.

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# How Does Small Hydropower Transform to be More Environmentally Resilient?

—From the Yangtze River Basin to the Yellow River Basin

*National Research Institute for Rural Electrification (NRIRE)  
Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (HRC)*

*LIN Ning, XIAO Yilun, SHEN Xuequn*

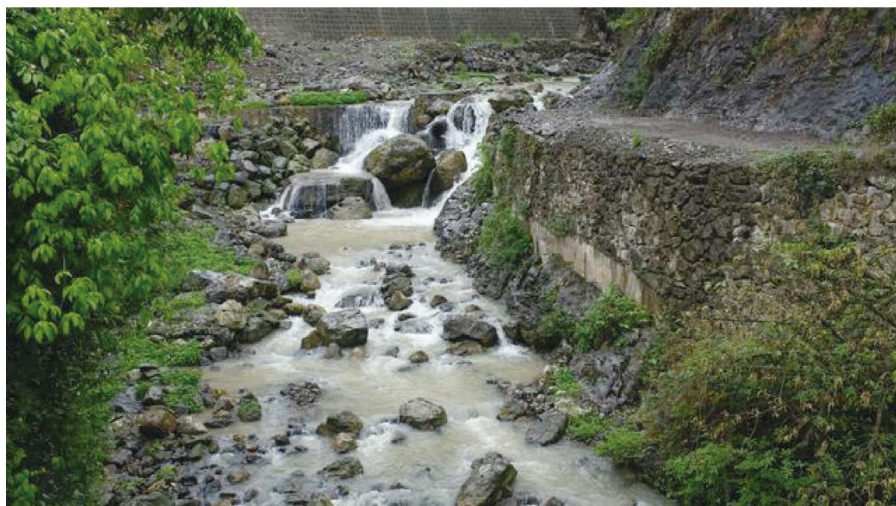
In order to solve the prominent ecological environmental issues caused by small hydropower plants, China has taken drastic measures to clean up and rectify small hydropower plants in the Yangtze River

basin since the end of 2018. More than 3,500 small hydropower plants have been completely shut down as they could not meet the environmental protection requirements. At the end of December 2021, seven ministries

including the Ministry of Water Resources jointly issued a document to start cleaning up and rectifying small hydropower plants in the Yellow River Basin, which will certainly be even stricter considering the Yellow River Basin is relatively water-scarce and ecologically more vulnerable than the Yangtze River Basin.

Small hydropower refers to hydropower stations with an installed capacity of 50MW or less, which is internationally recognized as a clean and renewable energy source. But in the past, due to the limitation of development concept and technical conditions, illegal construction, inadequate supervision and other reasons, small hydropower resources are overexploited in some areas of China. This situation led to flow reduction, flow cutoff or even dry up in some river sections, which severely affected local ecological environment.

From the Yangtze River basin to the Yellow River basin: How does small hydropower transform to be more



Liangfengdong Small Hydropower Plant was located in the Chishui River Basin, Weixin County, Zhaotong City of Yunnan Province. The barrage, E/M equipment, penstock, powerhouse and other facilities of the hydropower plant were all removed in June 2020. This picture shows the natural appearance of the riverbed after the demolition of Liangfengdong Small Hydropower Plant.

Photos in this article are all provided by Diao Fanchao, a reporter of ThePaper.cn.



environmentally resilient? Where are the further solutions to the problems related to small hydropower detected in the process of central ecological and environmental protection supervision? And how to position China's small hydropower in the new era? To answer these questions, ThePaper.cn recently interviewed Mr. Xing Yuanyue, President of International Network on Small Hydropower and also Deputy Director General of the Department of Rural Water Resources and Hydropower of the Ministry of Water Resources, P. R. China.

Mr. Xing Yuanyue pointed out that, small hydropower is an important energy choice for China to achieve the goal of "carbon peak and carbon neutrality", and the Chinese Central Government has set clear requirements to promote the development of green small hydropower based on the classification and rectification. Major strategies and policies, such as the *Action Plan for Achieving Carbon Peak before 2030*, the *Guidelines*

*on Promoting a New Pattern in the Large-scale Development of the Western Region in the New Era*, and the *Guidelines on Promoting High-quality Development of the Central Region in the New Era*, all require the development of green small hydropower. From the Yangtze River basin to the Yellow River basin, the overall goals of the cleaning up and rectification of small hydropower are to meet the standards of being green, safe, intelligent and beneficial to the people, as well as to realize the transformation, upgrading and green development of small hydropower in China.

### Details of the interview are as follows:

**ThePaper.cn:** What kind of foundation has been laid by the cleaning up and rectification of small hydropower in the Yangtze River basin towards the green transformation and

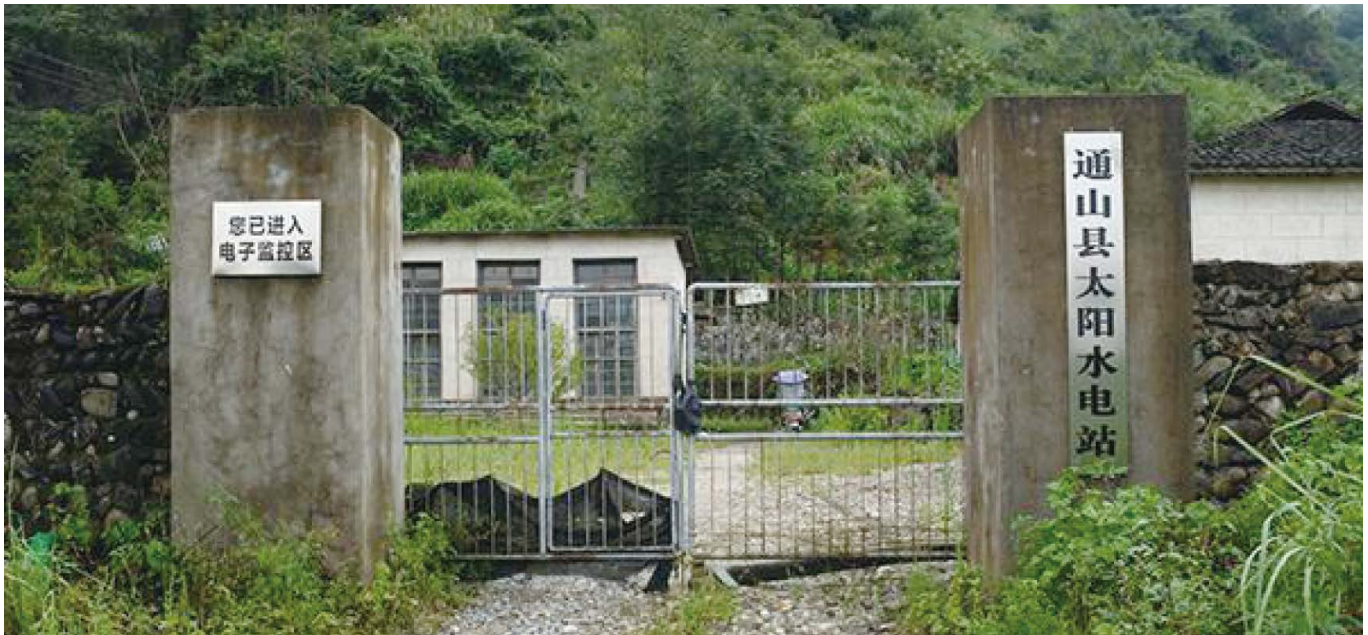
development of this industry?

**Mr. Xing:** Since 2018, the Ministry of Water Resources in conjunction with relevant ministries has organized and guided the local governments along the Yangtze River Economic Belt to complete the cleaning up and rectification of more than 25,000 small hydropower plants. Amongst the 4,000 small hydropower plants that are to be shut down, more than 3,500 have completed the procedure, while the rest will all be shut down before the end of this year. There are 21,000 small hydropower plants retained, all of whom have completed the rectification, and have entered the local supervisory system after ensuring ecological flow. After the rectification and shut down of these small hydropower plants, the authenticity and integrity of the natural ecosystem are effectively guaranteed, and the river ecological environment is effectively restored. The cleaning up and rectification of small hydropower plants in the Yangtze River basin led to a 15% decrease on the overall development intensity of small hydropower.

The cleaning up and rectification of small hydropower plants has brought several benefits. First, the concept of giving priority to ecology and green development has gradually gained popular supports. Second, the approach to rectify the prominent ecological environment problems of small hydropower plants has been found, which solved some critical long-standing problems that affect the ecological environment. Third, it has improved the institutional system of promoting the development of green small hydropower. Guidance and proposals were issued to strengthen



**Hongsha Small Hydropower Plant is located on the Xiaoxi River, the southern source of Liuyang River (a secondary tributary of the Yangtze River), in Hongsha Village, Zhangfang Township, Liuyang City of Hunan Province. This plant was put into operation in June 2006. It completed the rectification acceptance in July 2020.**



**Taiyang Small Hydropower Plant located in Jiugong Mountain National Nature Reserve, Hubei province.**

the supervision on ecological flow of small hydropower plants, and the shut-down procedure and acceptance of rectified small hydropower plants, as well as to attach importance to plants' routine supervision and inspection, etc. Evaluation criterion of green small hydropower has been revised. More than a dozen provinces have introduced measures to monitor the ecological flow.

**ThePaper.cn:** What would be the further solutions to the problems related to small hydropower found in the process of central government's ecological and environmental protection supervision?

**Mr. Xing:** The central environmental inspection has played a deterministic role and directly contributed to finding the solutions of a number of long-standing problems in the field of ecological and environmental protection, thus significantly improving the ecological environment in China. During the

implementation of cleaning up and rectification of small hydropower plants, the central environmental inspection has also played a deterrent role, which strongly promoted the resolution and governance of the negative ecological environment impact of small hydropower. In 2021, the central environmental inspection group criticized five small hydropower plants in a circulated notice, which are Erhegou Cascade-I Small Hydropower Plant in Wenshan Prefecture, Yunnan Province; Yiluo River Small Hydropower Plant in Luoyang City, Henan Province; Wenzhu Small Hydropower Plant in Zhaoping County, Guangxi Zhuang Autonomous Region; Jiugong Mountain Small Hydropower Plant in Tongshan County, Hubei Province; and Shanglitong Small Hydropower Plant in Luodian County, Guizhou Province. These small hydropower plants all have some problems, amongst which one plant was over-developed,

four were illegally constructed in protection zones, some had not paid sufficient attention to the cleaning up and rectification, thus neglecting their duties, and some did not apply scientific assessment or classification, therefore rectification measures were not in place.

Three measures were put forward to address the problems identified by the central environmental inspection group. First, to urge and guide local governments to make rectification as soon as possible. For instance, four of those five small hydropower plants mentioned above have already completed thorough rectification, while the one in Guizhou Province is stepping up efforts to carry out rectification. Second, local governments are required to draw inferential conclusions, and bring similar problems into the scope of rectification and rectify accordingly. Third, to guide provinces that have not yet carried out rectification to start this



task as soon as required.

## The cleaning up and rectification of small hydropower plants in the Yellow River basin should be carried out by following stricter standards

**ThePaper.cn:** What kinds of specific measures have been arranged for the cleaning up and rectification of small hydropower plants in the Yellow River basin?

**Mr. Xing:** In accordance with the relevant requirements stated in the *Outline of Ecological Protection and High-quality Planning in the Yellow River Basin* on cleaning up and rectification of excessive small hydropower development in the Yellow River basin, the Ministry of Water Resources organized a survey targeting the problems of small hydropower plants in the Yellow River basin. The Ministry also established an information management platform for small hydropower plants in the Yellow River basin and trained more than 500 technical and management personnel. Together with the National Development and Reform Commission and some other ministries, the Ministry of Water Resources worked out a plan to establish an inter-ministerial communication and liaison mechanism among various ministries, and carried out joint research with relevant ministries to issue documents on the cleaning up and rectification of small hydropower plants in the Yellow River basin. They also

held video meetings to kick off the rectification work. It is believed the problem of excessive development of small hydropower in the Yellow River basin could be resolved by 2024. Consequently, ecological flow of small hydropower plants can be effectively guaranteed. It is expected that by 2024, the connectivity of rivers in the Yellow River basin shall be improved significantly, and problems affecting normal flood discharge and downstream life, production and ecological water use shall be effectively solved. The negative impact of the over-development of small hydropower shall be eliminated basically, in order to maintain the authenticity and integrity of the nation's important natural ecosystems. Furthermore, a long-term effective mechanism of the sustainable development of small hydropower shall be established and perfected to provide supports towards the harmony between people and water, the improvement of ecological environment quality and the construction of the river of people's happiness in the Yellow River basin.

**ThePaper.cn:** What are the differences between the emphasis of the rectification along the Yellow River basin and that along the Yangtze River basin?

**Mr. Xing:** The Yangtze River basin possesses a large number of small hydropower plants, as well as a large installed capacity of which the power-generation-based installed capacity is relatively huge. Yet the number of small hydropower plants in the Yellow River basin is much less with only over 700 located within the whole basin, which is not on the same order of magnitude as that in the

Yangtze River basin. Moreover, thanks to the effect of central ecological and environmental protection supervision, media exposure and the instructions from the General Secretary of the CPC Central Committee in recent years, local governments along the Yellow River basin have already implied some rectification towards small hydropower plants in the basin. Therefore, the overall rectification task in the Yellow River basin is not as heavy as that in the Yangtze River basin.

However, the Yellow River basin is characterized with water scarcity and a vulnerable ecological system, making the construction of small hydropower plants a more sensitive work. Although the total amount of small hydropower plants is small, the requirements of ecological protection are stricter. Thus, the rectification of small hydropower plants in the Yellow River basin should be carried out in accordance with higher standards.

The rectification standards of small hydropower plants in the Yellow River basin are put forward based on the experience of the cleaning up and rectification of small hydropower plants in the Yangtze River basin. The procedure of rectification also includes problem verification, comprehensive evaluation, and specific solution implementation for each plant; then it will be rectified according to the classifications; and finally, the rectification is to be accepted. Another key point is to adhere to the problem-oriented principle, and pursuing rectification in accordance with different classifications, obeying laws and regulations, seeking truth from facts, and ensuring the safety of the project. The higher standards

are reflected in three ways. First, the comprehensive evaluations are all conducted at provincial level, which consider one river as one unit. According to the report of comprehensive evaluation, each power plant will categorize feedbacks and come up with custom-made rectification measures. Second, those small hydropower plants still using equipment and facilities that have been obsoleted by decree, or whose workshops are dilapidated and have negative effects to the landscape, are required to rectify according to the safety management regulations of small hydropower plants and meanwhile, carry out the construction of standardization of safety production. Third, those small hydropower plants that meet the standards of small reservoirs are required to clarify the management department, implement the dam safety responsibility system, determine persons in charge of the reservoir administration, routine inspection, and technical management, establish responsible bodies for the production and supervision of power plants, modify the operation management and protection mechanism, install water & rain regime system, and equip safety

monitoring facilities.

## The restoration of river ecological environment should be given the highest priority

**ThePaper.cn:** In the process of cleaning up and rectification of small hydropower plants, a number of plants have been shut down and removed; yet at the same time, in some areas new plants are still under construction. How to master the scale of demolition and construction?

**Mr. Xing:** After decades of development, the equipment and facilities of some small hydropower plants are gradually aging and have prominent safety risks, which affects the ecological environment and flood control safety. It is quite common to shut down and remove these small hydropower plants considering rectification is uneconomical. As for how to handle the scale of demolition and construction, the Ministry of Water Resources together with other relevant ministries issued the *Guidance on Further Implementation towards the Classification and Rectification of Small Hydropower*

*Plants* (hereinafter referred to as the *Guidance*) in the second half of last year, giving systematical answer to that question after joint research, thematic studies and repeated consultations. The *Guidance* adheres to the strict standards, insists in putting the restoration of river ecological environment at the prior place in the cleaning up and rectification of small hydropower plants. It focuses on the ecological integrity and the systematic governance of the basin, determines to manage ecological protection, achieve green development and improve people's livelihood, and makes clear requirements on the classification and rectification of small hydropower plants.

The "strictness" of the *Guidance* can be seen in five aspects. First, for the first time, the construction of new small hydropower plants is prohibited in principle, except for the projects that are to consolidate poverty-alleviation achievements, ensure power-supply security in remote areas such as isolated islands and rural areas not covered by the power grid, and imply the comprehensive water-utilization projects combined with power generation, such as water-diversion projects. Second, for the first time, the small hydropower plants with small installed capacity, low standards of construction management and safety, or aging equipment and facilities beyond repair, or whose rectification is uneconomic are encouraged to be shut down. Three, it lists five scenarios and those small hydropower plants meet any of them will be shut down. Fourth, in principle, when a small hydropower plant is shut down, its water-retaining structures including dams and power-



The powerhouse of a small hydropower plant located in Jiugong Mountain National Nature Reserve, Hubei Province.

generation facilities have to be removed to restore river connectivity. Fifth, it indicates that the rectification should eliminate potential safety risks, strictly follow the provisions to implement ecological flow and to restore river ecology.

At the same time, the *Guidance* also gives clear suggestions upon the problems inspected during the rectification of the previous period, for instance, unscientific assessment and inappropriate classification, inadequate implementation of rectification measures, insufficient verification on the demolition of power generation equipment while retaining the dams in some power plants, and passive impact on other functions of plants such as flood control, irrigation and water supply, etc. On the one hand, the overall rectification work should stick to a problem-oriented approach, follow the laws and regulations, seek truth from facts, carry out scientific assessments, and conduct category-based rectification. For those that have completed rectification, performing work reviews are necessary; for those that are still undergoing rectification, a further step to modify and optimize rectification measures should be taken in a coordinated manner; and for those that have not yet started the rectification, plans have to be formulated and rectification work need to be launched promptly. On the other hand, for the power plants that have clear comprehensive utilization tasks and whose dispatching operation modes are difficult to be replaced, they can be retained after being approved by provincial governments and finishing required modification procedures.

**ThePaper.cn:** The *Guidance* said

in principle no new small hydropower plant should be built. Yet for places with low intensity of small hydropower development, would there be new ones in the future?

**Mr. Xing:** According to the *Guidance*, in principle, there would be no more new small hydropower projects being approved to construct, except for those in charge of consolidating the achievements made in poverty alleviation, ensuring the security of power supply in remote areas such as islands, border areas and areas without power grid, or constructing the comprehensive water projects combined with power generation, such as water diversion projects. Other exception includes projects that have already started construction before the issuance of the *Guidance*, these projects can continue to be built only if they processed under proper procedures. However, projects that have been approved but have not yet started need to be re-assessed and reviewed.

### Small hydropower is an important energy choice for China to achieve its goal of “carbon peak and carbon neutrality”

**ThePaper.cn:** In the early stage of the cleaning up and rectification of small hydropower plants in the Yangtze River basin, the main measures adopted are administrative approaches. Yet in the future, how could the market play its role in the industry to stimulate the initiative of power plants owners to engage in ecological protection?

**Mr. Xing:** Small hydropower is a clean energy, and theoretically, its feed-in tariff should be roughly the same as those of solar and wind power. Nevertheless, for some reasons, the feed-in tariff of small hydropower is comparatively low, and in some places, the feed-in tariff of small hydropower has even fallen rather than risen. This situation has been actively reported to relevant government departments. It is hoped that through the green transformation of small hydropower, the pricing mechanism will be given with incentives under the condition where the ecological protection measures are in place, so that the policy on the feed-in tariff of small hydropower in concert with the cost of ecological restoration and governance can be formulated.

**ThePaper.cn:** What is the role of small hydropower in China’s green and low-carbon energy transition in the new era?

**Mr. Xing:** The central government has made specific requirements on promoting green development of small hydropower based on classified rectification. Major strategies and policies, for example, the *Action Plan for Achieving Carbon Peak before 2030*, the *Guidelines on Promoting a New Pattern in the Large-scale Development of the Western Region in the New Era*, and the *Guidelines on Promoting High-quality Development of the Central Region in the New Era*, all call for the development of green small hydropower.

First, there is the need for ecology priority and green development. Small hydropower is a clean and renewable energy. According to the data released by the World Energy Council and



the National Renewable Energy Laboratory of the US, the energy payback ratio of small hydropower is 9 times that of wind power, 56 times that of photovoltaic power and 68 times that of thermal power. In addition, the power generation efficiency of small hydropower is 2.2 times that of wind power and 3.5 times that of photovoltaic power respectively. Moreover, small hydropower projects can bring with social and ecological benefits through flood control, irrigation, water supply, tourism, protection of forest and vegetation and water conservation etc. Promoting the development of green small hydropower can comprehensively increase the utilization efficiency of hydro energy resources, enhance the supply and guarantee ability of clean electric power, strengthen the governance and restoration of river ecosystem, and restore the water ecosystem with lucid water and green shore.

Second, there is the need to promote carbon peak and carbon neutrality. In 2020, small hydropower generated more than 240 billion kWh of electricity, equivalent to the annual power output of 2.15 The Three Gorges Hydropower Station, and accounts for about 25% of hydropower generation and 10% of non-fossil energy generation respectively. This equals to save 74 million tons of standard coal per year and reduce carbon dioxide emissions by 185 million tons. For a long time, small hydropower has been an important energy choice to realize the target of carbon peak n and carbon neutrality.

Third, there is the need to enhance the regulation capacity of power grid.

There are more than 5,800 small hydropower plants with reservoir storage capacity of 0.1 million m<sup>3</sup> or more, and mainly served for generating electricity around the country. These small hydropower plants have a total storage capacity of more than 80 billion m<sup>3</sup> and a total installed capacity of more than 25 million kW, but are largely not involved in power dispatching. Based on small hydropower, integrated construction of hydropower, wind energy, solar energy and energy storage can promote the development and consumption of wind energy, solar energy and other renewable energies, thus enhancing the reliability of power supply.

Fourth, there is the need to maintain the security of power supply. Small hydropower is the local fundamental power supply and the emergency security power supply for key users. The development of green small hydropower can effectively enhance the emergency power supply capacity.

**ThePaper.cn:** From the cleaning up and rectification of small hydropower plants in 2018 to the 14<sup>th</sup> Five-Year Plan and to the future, what goals or visions does small hydropower hope to achieve in its development?

**Mr. Xing:** The overall goal is to realize the transformation and upgrading and green development of small hydropower oriented on the requirements of being green, safe, intelligent and beneficial to the people. To be more specific, firstly, to deepen the cleaning up and rectification of small hydropower plants and optimize the untouched small hydropower plants, and to effectively solve the problem of excessive development of small hydropower in the Yangtze

River Economic Belt, the Yellow River basin and other river basins. Secondly, to strengthen the safety supervision to safeguard public security, to continue organizing the investigation and treatment of hidden dangers, strengthen the risk management and control at different levels, carry out the standardization construction of safe production of small hydropower plants, consolidate the safety foundation, optimize the safety monitoring system, and promote the informatization of safety supervision. Thirdly, to promote the green transformation and modernization of small hydropower plants at county or county-level rivers, and build modern small hydropower plants with complete systems, high efficiency, and practical, intelligent, green, safe and reliable characteristics. Fourthly, to implement ecological flow and restore river ecology, strengthen the monitoring of ecological flow of small hydropower projects, continue to discharge ecological flow in accordance with regulations, carry out the treatment depending on local conditions towards the river section where water is reduced, and restore river connectivity. Fifthly, to promote the construction of demonstrative green small hydropower plants, build a batch of eco-friendly, socially harmonious, standardized and economically reasonable green small hydropower plants as demonstrations and typical rivers of green small hydropower with a harmonious human and water relationship.

**(Source:** 17 February 2022 from ThePaper.cn. Translated by LIN Ning, XIAO Yilun, SHEN Xuequn, Foreign Affairs and Training of HRC, Contact: nlin@hrcshp.org) ■

# Human Resources Capacity Building on SHP and Rural Electrification in Rwanda

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*ZHANG Hua, SHI Jin, SHEN Xuequn*

**H**RC, the Family of SHP in the World, so far has implemented 6 training programs for Rwanda since 2015, with the participation of 318 local professionals.

2021 marks the 50th anniversary of the establishment of diplomatic relations between the Republic of Rwanda and the People's Republic of China. This is a milestone in further advancing the solid partnership between the two countries based on the steady development of bilateral relations since the establishment of diplomatic ties.

In recent years, the relationship between China and Rwanda has entered a rapid development track with continued further cooperation, especially after President Kagame's visit to China in 2017 and President Xi Jinping's visit to Rwanda in 2018. At the 2018 Beijing Summit of the Forum on China-Africa Cooperation, President Xi Jinping said that China would sponsor seminar and workshop opportunities for 50,000 Africans in the next three years.

National Research Institute for Rural Electrification, Ministry of Water

Resources (hereinafter referred to as "NRIRE"), also known as Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (HRC), is an international regional organization established in Hangzhou in November 1981 with the co-sponsorship of the Chinese Government and UN organizations including UNDP and UNIDO. As a research, training, information, and consultation organization for SHP, HRC serves as an important window for international cooperation in the field of SHP.

In order to fulfill the commitments of China-aid human resources development, entrusted by the Ministry of Commerce of China, and invited by Rwanda Energy Group, HRC has sent experts to Rwanda to organize bilateral technical training on small hydropower and rural electrification since 2015, with the participation of 318 local officials and professionals in the field of electric power, energy and water conservancy. With a wide range of participation, rich contents, and fruitful results, the training programs have won unanimous praise from the competent

authorities and partners in Rwanda. In addition, the experts from HRC also have provided technical consultation for relevant river basins and several small hydropower development and reconstruction projects in Rwanda, making positive contributions to jointly promoting China-Rwanda cooperation and friendship and further deepening the bilateral relations.

## I 2015 Training Course on Small Hydropower Technology for Rwanda

Under the guidance of the Ministry of Commerce, the Ministry of Water Resources, P.R. China and the Chinese Embassy in Rwanda, and with the strong support of Rwanda Energy Group and the Training Alumni of HRC, "2015 Training Course on Small Hydropower Technology for Rwanda" organized by HRC was successfully held in Kigali, the capital of Rwanda from July 6<sup>th</sup> to July 25<sup>th</sup>. 25 participants from Rwanda Energy Group attended this training course.

During the 20-day training course,





the technical presentations on design, construction, equipment, automation, and technical rehabilitation of hydropower stations were delivered, and the on-site visits were arranged and paid to the Munkunga River and Munkunga I small hydropower station in the Northern Province of Rwanda.

In addition, HRC signed a memorandum of understanding with Rwanda Energy Group Energy Development Company Limited for further cooperation in the field of small hydropower and renewable energy. The

closing ceremony was grandly reported by the local media.

## II 2016 Training Course on Small Hydropower Technology for Rwanda

Entrusted by the Ministry of Commerce of China, the "2016 Training Course on Small Hydropower Technology for Rwanda" was successfully held in Kigali, the capital of Rwanda from July 17<sup>th</sup> to August 15<sup>th</sup>.

The 30-day training course covered

lectures and on-site visits regarding the management and operation of hydropower station. 30 engineers and administrators from the Ministry of Infrastructure, Rwanda Energy Group, Integrated Polytechnic Regional Research Center, Rwanda MINEGA Energy Corporation attended the training.

The training course received strong support and high appreciation from Rwanda side, and the two sides actively explored the potential for extending the cooperation mode from the implementation of training programs to the establishment of a local vocational education and training center.

## III 2017 Training Course on Small Hydropower and Rural Electrification for Rwanda

During Sept. 13<sup>th</sup> –Oct. 7<sup>th</sup>, "2017 Training Course on SHP and Rural Electrification for Rwanda" was successfully held in Kigali, Rwanda by HRC with the coordination of Energy Development Co. Ltd. (EDCL) of Rwanda Energy Group. A total of 31 participants from MININFRA, EDCL, Integrated Polytechnic Regional Center, Ngali Energy Ltd., Novel Energy, Prime Energy Ltd., Pepro Ltd. and So Energy International, etc. attended this training.

Much attention was paid to this training and HRC dispatched staff earlier to arrange local training activities in Rwanda including training subjects, study tours, and work scope, which were optimized based on investigation. The training focused on field survey, field measurement, project design and equipment selection, so as to improve



## 2017年卢旺达小水电及农村电气化海外培训班 2017 Training Course on Small Hydropower and Rural Electrification for Rwanda

2017年9月13日—10月7日 13<sup>th</sup> September—7<sup>th</sup> October, 2017

卢旺达·基加利 Kigali·Rwanda

主办单位：中华人民共和国商务部

Sponsor: Ministry of Commerce of the People's Republic of China

承办单位：水利部农村电气化研究所/亚太地区小水电研究培训中心

Organizer: National Research Institute for Rural Electrification/HRC



the skills of Rwandan engineers for feasibility study and preliminary design of SHP and rural electrification.

This training covered the subjects of hydrology, geology, civil works, mechanical engineering, electrical engineering, construction management, etc., and presented some key issues of the feasibility study and preliminary design. The study tour was arranged to investigate the Nyabeshaza hydropower site, and based on site conditions, HRC

professors taught participants to compile the feasibility study report. This training achieved the target of improving the expertise and experience of local professionals through technology sharing and transfer.

## IV 2018 Training Course on Small Hydropower Technology for Rwanda

Entrusted by the Ministry of

## 2018 年卢旺达小水电技术海外培训班 2018 Training Course on Small Hydropower Technology for Rwanda

2018 年 7 月 16 日—8 月 9 日 16<sup>th</sup> July—9<sup>th</sup> August, 2018

卢旺达·基加利 Kigali·Rwanda

主办单位：中华人民共和国商务部

Sponsor: Ministry of Commerce of the People's Republic of China

承办单位：水利部农村电气化研究所/亚太地区小水电研究培训中心

Organizer: National Research Institute for Rural Electrification/HRC



Commerce of China, the "2018 Training Course on Small Hydropower Technology for Rwanda" was successfully held by HRC in Kigali from July 16<sup>th</sup> to August 9<sup>th</sup>. 50 technicians and administrative staffs from Rwanda Energy Group, University of Rwanda, IPRC, UTAB, COFORWA, Ngali Energy Group, Novel Energy, Prime Energy, and Rwanda Mountain Tea attended the training.

To accommodate the needs of Rwanda, the 25-day training content included not only practical experience on SHP development and rural electrification construction, as well as proven technology and advanced equipment, but also covered water management, dam safety, river conservancy and other related fields. Besides, site visits were arranged to the renewable energy laboratory of University of Technology and Arts of Byumba (UTAB), and Mukungwa-I hydropower station in Musanze, the north province of Rwanda.

This training course is a comprehensive expansion and upgrading transformation of small hydropower technical training, further deepening the training content and theme, strengthening the training effect and results.

## V 2019 Training Course on Small Hydropower Technology in Rwanda

From November 13<sup>th</sup> to December 7<sup>th</sup>, the Training Course on Small Hydropower Technology in Rwanda was held by HRC successfully in Kigali, Rwanda. It is the 5<sup>th</sup> one accomplished in Rwanda starting from 2015. Under





the careful guidance and strong support of the Training Center of the Ministry of Commerce and the Chinese Embassy in Rwanda, and with the joint efforts of HRC, Energy Development Corporation Ltd. (EDCL) of Rwanda Energy Group, the 25-day foreign-aid training program entrusted by the Ministry of Commerce has achieved fruitful results.

During the training, the participants were given lectures on advanced technology and practical experience in the fields of small hydropower development, safe operation of small hydropower, ecological small hydropower, rural electrification construction, water resources management and dam safety, etc. Site visits were arranged to Kavumu small hydropower station in Northern Province, water resources engineering laboratory of College of Science and Technology, University of Rwanda (CST-UR), High E-tech smart grid laboratory of African Centre of Excellence in Energy For Sustainable

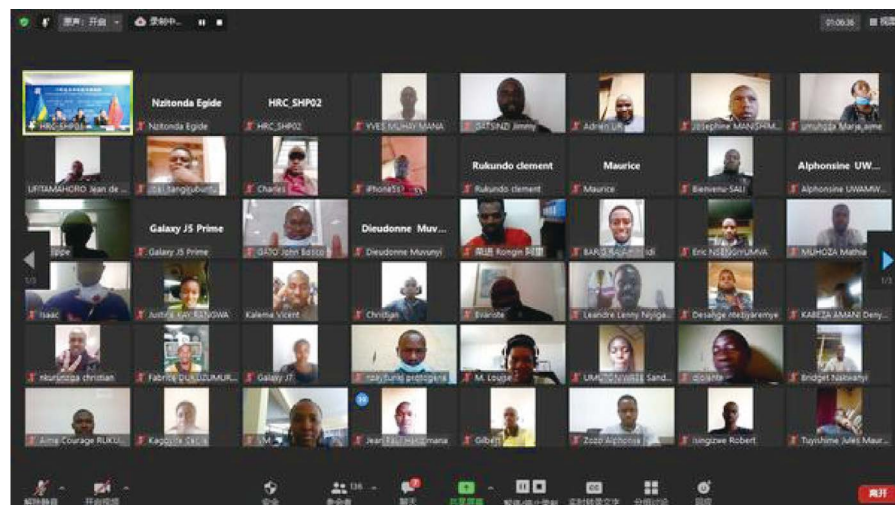
Development, and NZOVE water treatment plant. In addition, the participants also attended the first "Seminar on China Human Resources Development Training Program" organized by the Chinese Embassy in the Republic of Rwanda.

## VI Seminar on Small Hydropower Technology for Rwanda(Online)

From November 22<sup>nd</sup> to December

16<sup>th</sup>, the Seminar on Small Hydropower Technology for Rwanda sponsored by the Ministry of Commerce of China and organized by HRC was held online successfully. 137 participants from Rwanda Energy Group, University of Rwanda, Sustainable Agriculture and Livestock Initiative (SALI), and other local utilities and universities attended this rewarding event. It is the 6<sup>th</sup> one conducted for Rwanda starting from 2015.

During the seminar, participants listened to the presentations covering the technology, practice and experience in the field of renewable energy in China inclusive of SHP and solar energy, and carried out online visits to South-to-North Water Diversion Project, Water Conservancy System in Liangzhu Ancient City, Tianhuangping Pumped Storage Power Plant, Yucun Village with Green Development, NARI Group Corporation, National Water Museum of China, etc. In addition, further bilateral cooperation on SHP was discussed in detail, and traditional culture was shared via the rich activities, such as daily Chinese learning, the appreciation of



Chinese paper-cutting, etc.

Since 2015, HRC has continued to well carry out "go global" foreign aid training programs, with significant improvement not only in terms of training topics and content, but also in terms of training mode and scale. The technical training has cultivated hundreds of management and technical personnel in the field of SHP and other renewable energy, enhancing the overall level of rural electrification construction

in Rwanda, promoting the development and utilization of renewable energy resources in the country and promoting the development of local people's livelihood. In addition, China has actively expanded bilateral cooperation while carrying out technical training, and signed memorandums of understanding with Rwanda Energy Group Energy Development Company Limited, Ngali Energy, Byumba University of Arts and Sciences (UTAB), and Rwanda

Sustainable Agriculture and Livestock Initiative. HRC has provided technical services for the Chinese enterprises in Rwanda to implement the turnkey hydropower projects. HRC has made initial achievements in cooperation with Rwanda in the field of small hydropower, solar energy and other renewable energy development, as well as rural electrification construction.

### Photos of the Training Programs:



The Economic and Commercial Counsellors of the Embassy in Rwanda were present at the sites of the training courses



Certificate awarding





**Technical training**



**Participating in the First Seminar on China Human Resource Development Training Programs**

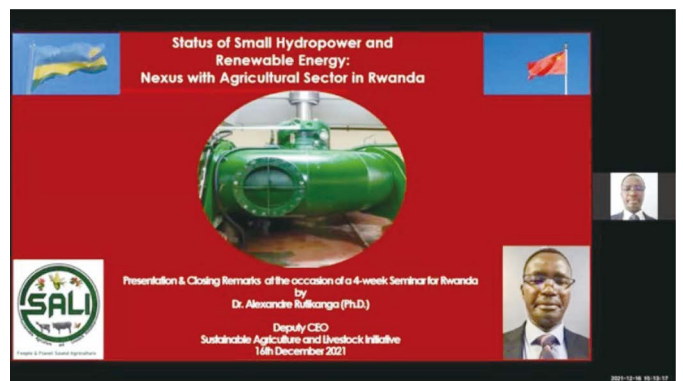


**Live teaching**





Discussion during the coffee break



Cooperation and exchange



Going into community to communicate with the local people heart by heart



Online cultural exchange

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# Project Progress of China-Pakistan Joint Research on Small Hydropower Technology(I)

*National Research Institute for Rural Electrification (NRIRE) / Hangzhou Regional  
Centre (Asia-Pacific) for SHP (HRC)  
Pakistan Council of Renewable Energy Technologies (PCRET)*

*XIAO Yilun, SHANG Cheng*

*August 2021*

## 1 About the Research Project

### 1.1 Background

In recent years, China and Pakistan had launched a number of technical cooperation in the field of small hydropower. In August 2015, "China-Pakistan Joint Research Centre for Small Hydropower" was officially set up after being unveiled by Chinese President Xi Jinping and his Pakistani counterpart. In June 2019, the Centre was accredited by the Ministry of Science and Technology of China to be one of the first fourteen "Belt and Road" Joint Laboratories.

### 1.2 Brief Introduction

This project, "China-Pakistan

Joint Research on Small Hydropower (SHP) Technology", is led by National Research Institute for Rural Electrification (NRIRE) and supported by Pakistan Council of Renewable Energy Technologies (PCRET). The total execution period is three years from November 2020 to October 2023. By means of technical exchanges, mutual visits, joint research, technical showcases and personnel training, this joint research project aims at conducting cooperation on SHP technical standard formulation and the construction of demonstration sites in terms of hybrid power-generation and cascade monitoring & control, thus realizing the overall target on setting up the China-Pakistan SHP "Belt and Road" Joint Laboratory. The project also focuses on talent development, especially high-level experts engaged

in SHP technology. The ultimate goals of the project are to further encourage Pakistan and other South Asian countries to improve their development and management of SHP and other renewable energy sources, and play a positive role in optimizing electric power supply, promoting poverty alleviation and protecting the ecological environment.

## 2 Working Progress and Outcomes

### 2.1 Kick-off Meeting

On February 8th, 2020, NRIRE, together with PCRET, Energy Department, Government of Punjab (ED Punjab) and Pakistan Standards & Quality Control Authority (PSQCA), held an online kick-off meeting to discuss the implementation

plan and work scope of each side. The meeting agreed as follows:

1. Work of the project for Pakistani side shall be undertaken by PCRET, ED Punjab and PSQCA. PCRET shall coordinate all the Pakistani partners.

2. PCRET shall collect and list all the questions of Pakistani side concerned about the project proposal. Then Chinese side shall make clarifications accordingly in written.

3. Taking the actual needs of Pakistani side and the feasibility of on-site construction into full consideration, Chinese side shall make plans for the construction of two demonstrative sites according to the project prescription. The two demonstrative techniques are the centralized control technology for optimal operation of cascade SHP plants within a basin, and the SHP-based off-grid hybrid generation system integrating solar and wind power.

4. Chinese side shall provide an equipment supply list of electromechanical devices for the demonstrative site at which the hybrid system will be installed once the specific site location is determined by the Pakistani side.

## 2.2 Implementation Plan Review Meeting

On the morning of 12th March 2021, the review meeting on the

implementation plan for “China-Pakistan Joint Research on SHP Technology” was successfully organized by NRIRE. The meeting was launched online and on-site simultaneously. Ms. Xu Jing, Director of the Department of International Cooperation, Science and Technology of the Ministry of Water Resources of China, attended online and addressed the meeting. Mr. Wu Shiqiang, Vice President of Nanjing Hydraulic Research Institute, came to the on-site meeting and delivered a speech.

Experts of the project advisory group, respectively from Development Research Center of the Ministry of Water Resources of China, Dam Safety Management Center of the Ministry of Water Resources of China, International Center for Small Hydro Power, Tsinghua University, Zhejiang University, Zhejiang Ocean University, Representative Office of China Three Gorges Corporation in Pakistan, and Zhejiang New Energy Investment Group Co., Ltd. etc., attended the meeting and put forward advice in terms of the advanced technology, cooperation concept and mode, risk prevention and control, publicity and talent training, etc.

Also presented at the meeting were Ms. Wang Jinsu, Consultant Director from the Department of International Cooperation, Science and Technology of the Ministry of Water Resources of China, Mr. Xu

Jincai, Director General of HRC, Mr. Dong Dafu, Deputy Director of HRC and the Project Leader, as well as other project team members.

The meeting agreed that this project carries political significance and has solid foundation for cooperation; while the implementation plan is clear with project’s targets and goals, and is feasible in the details of technical practice. All the experts of the project advisory group believed that the overall technical risk of project implementation is low. At the same time, they also suggested that: 1) the development experience of China’s SHP should be highlighted in the implementation process so as to seek long-term cooperation; 2) an excellent publicity of the project will enhance all-round benefits of the cooperation; 3) risk mitigation measures of the project can be developed initiatively through risk prevention and control analysis; and 4) all the resources have to be integrated in order to perform a good job in project implementation.

## 2.3 Seminar on “the Standard for Small Hydropower Technology”

The first international seminar of this project was held successfully in Hangzhou on 10th May, 2021. The seminar focused on the status quo and demand analysis of small hydropower technical standards. It was organized



jointly by NRIRE, PCRET and PSQCA. The seminar was launched online and on-site simultaneously. The online participants were experts and scholars from over nineteen countries and regions including Afghanistan, Angola, Bangladesh, Cambodia, Ecuador, Egypt, Ethiopia, Georgia, Indonesia, Laos, Malaysia, Mongolia, Nepal, Pakistan, Rwanda, South Africa, Tanzania, Vietnam and Zambia. All the team members of the project and several senior engineers from NRIRE had attended the seminar on-site.

Dr. Iqbal Hussain, Director of Hydro of PCRET, made an opening remark at the beginning of the seminar. Later, the seminar had Mr. Meng Ke, Ms. Zhou Lina, and Dr. Cui Zhenhua, all of whom are senior engineers from HRC, to give presentations on relevant topics. Also, the seminar invited Mr. Muhammad Ashraf Palari, the Deputy Director of PSQCA, Mr. Roshan Pandey, the Chief of SHP Programme at Nepal Academy of Science and Technology (NAST), and Mr. Adan Mangal, an Energy Efficiency Expert of Afghan National Standard Authority, to deliver presentations respectively. Finally, The Project Leader Mr. Dong Dafu drew a brief conclusion at the closing ceremony.

Through the exchange and discussion upon the standards of SHP technology, this seminar

further enabled participants to enhance their personal and mutual understanding towards the technical standards of SHP, which then could lay a solid foundation for carrying out cooperation in the field. Also, the seminar suggested that all the participating countries should find out the common problems in SHP standards; draw on lessons from their own experience and characteristics to extracting typical SHP standards frameworks that consistent with actual needs. These frameworks would then promote multilateral cooperation in terms of small hydropower technology, projects development, plant operation & maintenance among developing countries. SHP, being a clean renewable energy, has its advantages to be fully exploited in the fields of energy conservation and emission reduction, which can have huge contribution to curbing the global climate change.

## 2.4 Talents Cultivation Plan

### 2.4.1 Qualified Participants

Foreigners possess master degree in water management, renewable energy or related field; have more than five years of relevant working experience as the technical personnel in their department; under the age of 45, and whose English language skills meet the entry requirements for the programme.

### 2.4.2 Programme Duration

From September 2021 to February 2022.

### 2.4.3 Objectives

Through capacity building for talents, this cultivation plan aims to establish a long-term stable exchange and training mechanism for SHP technical personnel. The whole training programme targets at practical and innovative learning, and shall raise a team of high-level professionals engaged in SHP technology and management in order to promote international cooperation in SHP.

### 2.4.4 Curriculum

According to the contents and learning modes, all the courses are categorized into two modules: public fundamental courses and professional skill courses. Public fundamental courses include public required courses, such as Chinese language; and optional extensive courses in the fields of social science and computer engineering. Professional skill courses consist of major compulsory courses and optional courses for professional improvement. Compulsory courses contain technical training, project management, and social commerce that are related to SHP technology; while optional courses for professional improvement emphasize in engineering, energy, environment etc., which can offer participants opportunities to enhance themselves.

The talents cultivation plan is supported by NRIRE and Hohai University together. The final grades will be calculated by learning hours and credits in accordance with Hohai University's curriculum.

#### 2.4.5 Teaching Mode

Being affected by Covid-19, all the teaching activities will be carried out online. Meanwhile, regular communications are provided by project team managers and academic supervisors so as to offer participants research guidance. Project team managers and academic supervisors will also assign several tasks to participants regularly according to the different progress period of the joint research project, and corresponding solutions will be provided later. It is expected that this mode of teaching and learning shall strengthen participants' capabilities to solve practical problems.

#### 2.4.6 Financial Incentives

There are several types of scholarships set for this training programme.

### 2.5 Joint Research and Application of Technology

Based on the concept of remote control and digitalization, the project team proposed to develop the integrated monitoring technology for small hydropower stations, and the related technical research was

conducted. The data channels from cascade small hydropower stations to the integrated control center in the region are set up by renting or building the private communication network. Through the data communication technology, interaction between the monitoring system data of the power station and the data of the centralized control terminal is realized. Through the optimization algorithm, the remote automatic regulation on power generating units and other functions are realized. By adopting video technology, the video information from the power stations is transmitted to the video platform of the centralized control center, so that a group of operators in the centralized control center can carry out all-round remote monitoring on cascade power stations. At the same time, the intelligent technology is adopted for the integrated monitoring platform, so as to ensure the safe operation of the power stations, reduce the workload of operators and improve the supervision efficiency.

The technology has been promoted and applied in China. By adopting the integrated monitoring technology for SHP, the integral management was carried out for Jiufeng Hydropower Station, Shafan Cascade II Hydropower Station and Hepanqiao Hydropower Station which are affiliated to Lanbo Energy Co. Ltd. in Jinhua, and the total number

of operators was reduced from 40 to 10. The same was implemented for Hengjin Hydropower Station and Geshan Hydropower Station affiliated to Hengjin Reservoir Management Center in Dongyang. "Unattended Operation" has been realized in Geshan Hydropower Station, and the number of operation groups for the two stations was reduced from two to one, alleviating the problem of understaffing. By adopting the integrated monitoring technology, with the intelligent control function of water flow, the power generating units can be regulated automatically according to the water level of forebay, not only reducing the workload of operators, but also improving the utilization rate of water energy, which thus has won high evaluation from the owners. In the next step, it is planned to select a site in Pakistan for demonstration.

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# Project Progress of China-Pakistan Joint Research on Small Hydropower Technology(II)

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Centre (Asia-Pacific) for SHP (HRC)  
Pakistan Council of Renewable Energy Technologies (PCRET)*

*SHANG Cheng, XIAO Yilun, SHEN Xuequn*

*December 2021*

## 1. About the Research Project

### 1.1 Seminar on Remote Centralized Control Technology for Operation and Management of SHP

On the afternoon of September 23, 2021, the second international seminar of the China-Pakistan Joint Research on SHP Technology kicked off, with the theme of SHP remote centralized control technology for operation and management. Co-organized by NRIRE/HRC and PCRET, the seminar was held offline and online simultaneously.

The project team members from the South Asian countries such as Pakistan and Nepal attended the seminar online, while the project team members in China and the experts with NRIRE/HRC were present at the offline seminar. In addition, the

seminar also attracted the experts and professionals from Azerbaijan, Cambodia, Ghana, Indonesia, Kiribati, Iraq, Laos, Mongolia, Morocco, South Africa, Tunisia, Uzbekistan, Venezuela, Vietnam, Zambia and Zimbabwe to the seminar online.

The Deputy Director General Mr. Dong Dafu delivered a speech at the opening ceremony on behalf of NRIRE/HRC, extending the warm welcome to the representatives of Pakistan and other South Asian countries as well as the representatives of other BRI countries for their active participation, and introduced the background of the project and the content and goals of the seminar. Mr. Hussain Iqbal, Director of Micro Hydropower Department of Pakistan Council of Renewable Energy Technologies (PCRET), made an address on behalf of the participants, expressing their appreciation to NRIRE/HRC for its continuous support to the developing

countries, especially to Pakistan for the promotion and demonstration on micro and small hydropower development. He said that this seminar will be a practical and in-depth technical exchange in the fields of climate change, green energy and small hydropower.

At the seminar, Mr. Chen Ting, senior engineer of NRIRE/HRC, introduced the project content, implementation plan, project progress, as well as the achievements in standard framework formulation, database collection and sorting, talent cultivation, centralized control technology, off-grid hybrid power generation technology, product demonstration, and the construction of the joint laboratory for small hydropower.

At the invitation of the seminar, Engineer Wu Tao, Senior Engineer Hu Changshuo and Professoriate Senior Engineer Xiong Jie from



School of International Education, Hohai University was also invited to introduce Hohai University International Student Program to the students. At the same time, our project team also arranged two special lectures on the application of photovoltaic technology and green small hydropower for the students.

The following consensus was reached in this online exchange meeting.

(1) Depending on the actual situation, more flexible study options will be given to the participants and the special evaluation criteria would be formulated.

(2) The course recordings will be provided as more as possible for the participants to review after class, and the Chinese teachers will share lecture materials after class for the participants to review and consolidate their learning.

(3) The presentations focused on topic of water culture will be arranged for the participants in January 2022.

(4) The experts and scholars in the industry concerned will be invited to deliver a series of online specialized training program or courses on renewable technologies for

NRIRE/HRC, Engineer Tahir Ahmed from Power Development Organization of Azad Jammu & Kashmir (AJ&K), Pakistan, and Mr. Pandey Roshan, Chief of Small Hydro Power Program of Nepal Academy of Science and Technology make the presents respectively titled *Technical Renovation for Small Hydropower Station, Centralized Monitoring of Small Hydropower, Secondary Electrical Equipment, Hydro Power Sector in AJ&K and Automation of SHP Stations and Introduction of Automation of Hydropower Station in Nepal*.

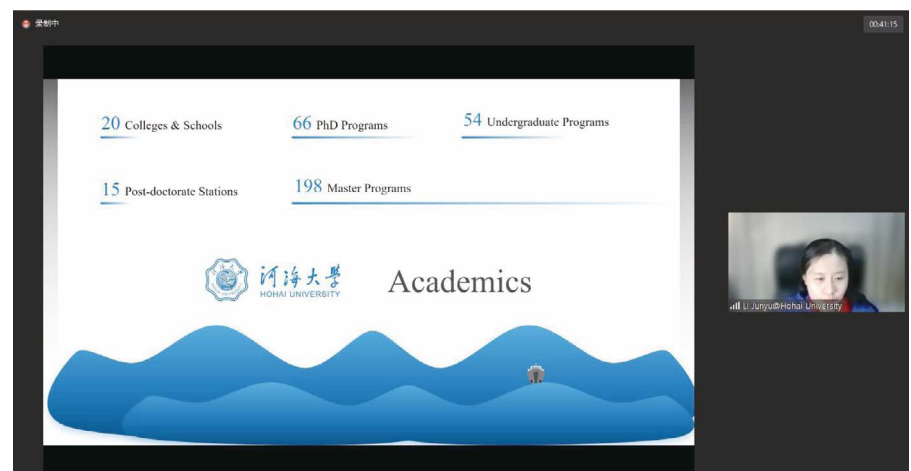
During the seminar, the extensive and in-depth technical exchange and discussion were carried out, which popularize the remote supervision and control technology for SHP and promote the implementation on the China-Pakistan joint research project on SHP. It is highly expected that all the participating experts and professionals will make joint efforts in the research and application of this practical technology, so as to commonly promote the sustainable utilization and development of SHP and other renewable energies.

## 1.2 Cultivation of Young Scientists in Water Sector for the South Asian Countries

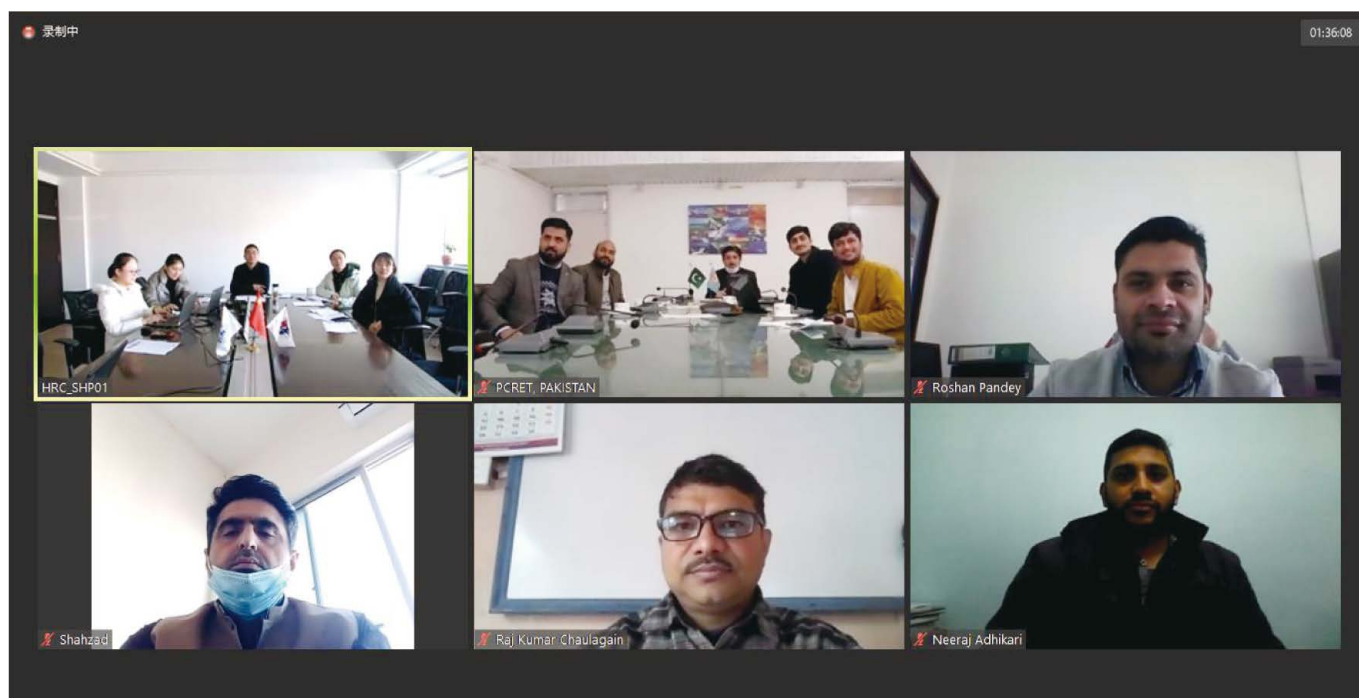
In mid-September, the enrollment

and admission of the training program for young scientists in water sector was completed. Ten young professionals from Pakistan and Nepal undertook the online registration for the fall semester of the 2021 academic year, and selected personal training plans according to the curriculum. All online courses started in early October.

In order to better serve the talent cultivation plan, on the afternoon of December 17, 2021, the project team convened an online exchange meeting with 10 young professionals who participated in the talent training plan. At the meeting, 10 students shared their experience of participating in online training courses in the past three months, fully affirmed the teaching level and course content of the teachers, and discussed ideas and opinions on talent training with the project team. Ms. Li Junyu, director of the Academics Office,







the participants to further enrich the course content.

## 1.3 Second Technical Liaison Meeting

On the afternoon of December 17, 2021, the second technical meeting was held jointly by NRIRE, PCRET and PSQCA, the main parties of the cooperative project of China-Pakistan Joint Research on SHP Technology, and the further action plan was made based on the implementation progress. At the meeting, both sides made the in-depth exchange with the Pakistani colleagues on the construction of technical demonstration site, the promotion of SHP technical standards, as well as the cooperation on MHP and solar energy with Gilgit-Baltistan Government.

The detailed items of the meeting are as follows:

1. The up-gradation of the existing

laboratory at PCRET Islamabad

NRIRE /HRC and PCRET will prepare jointly the detailed layout plan for the up-gradation and PCRET will carry out the civil and other related works as per the plan. After that, the installation of equipment will be conducted.

2. 100kW hydropower plant at IRI Punjab

PCRET will try to engage Energy Department Punjab to carry out the work on the proposed site. It is also suggested to NRIRE/HRC that the amount allocated for 100kW may be converted to solar irrigation project in Punjab. Meanwhile, in parallel, PCRET will also try to find out similar water head (2m) on a canal in other provinces in Pakistan.

3. Formulation of Small Hydropower Standard System in Pakistan

An agreement between PCRET, PSQCA and NRIRE/HRC

will be made for this purpose.

4. Cascaded Hydropower Plant

Initially sites in AJ&K will be surveyed.

5. Hybrid Power Generation Plant

Initially 100kW site in IRI Punjab will be considered but as alternate option, suitable site in AJ&K, Gilgit-Baltistan or KPK will be surveyed.

6. Agreement with Gilgit-Baltistan Government for hydropower development

PCRET agreed to take up the matter with the GB Government.

7. Masters Scholarship in China

NRIRE/HRC informed that MWR of China has a Masters Scholarship Program and PCRET will participate in it. The details of the scholarship program will be shared with PCRET by NRIRE/HRC.

8. Solar Water Systems for Irrigation, Home electrification

PCRET agreed to hunt for avenues of cooperation and stakeholders in



solar water system for irrigation and home electrification in Pakistan. Relevant support will be provided by NRIRE/HRC.

#### 9. Other International Projects

For Biogas promotion, Biogas department of PCRET will take up with the Biogas Institute of Ministry of Agriculture (BIOMA) of China for future collaboration. For Solar PV, Agreement with Heroboss, China is in progress.

In addition, more agreements were presented and clarified as follows:

1. NRIRE/HRC welcomes the participation of engineers or officials from PCRET and PSQCA in the training workshops or seminars organized in Hangzhou, China with Chinese expertise or technologies shared in the fields of small hydropower, rural electrification and other renewable energies.

2. At the request of PCRET and PSQCA, training courses or seminars can be organized either in China or Pakistan jointly by NRIRE/HRC and PCRET and PSQCA so as to improve the capacity building

in the field of standardization and conformity assessment. Sharing the expertise and practice from all Parties, standardization framework, adaptation and its implementation based on small hydropower and rural electrification for South Asia can be carried out.

3. The Parties agree to work jointly on the research programs, such as the standard comparison of SHP and rural electrification in different countries, standard setting and promotion, etc.

4. The Parties shall work to set up a standard framework of SHP and rural electrification technology in South Asia in terms of resource evaluation, development planning, survey design, operation management, sharing and drawing on the practical experience and technical standard in China.

### 1.4 Annual Implementation Report & Scientific and Technological Report

In early December, the project team completed the annual project implementation report and scientific

and technological report. The implementation report summarized the progress of the project, including all the work carried out, all the achievements achieved and the next work plan. The scientific and technological report summarized the implementation of various tasks according to the requirements of the project mission statement, covering the research on framework system of SHP technical standards in South Asia, the research on the training mechanism of SHP technical personnel in South Asia, the joint research on centralized control technology for optimal operation of multiple small hydropower stations, the joint research on the stability of off-grid hybrid power generation based on SHP, the trial production and demonstration of SHP and other renewable energy equipment, and the platform building of the China-Pakistan joint laboratory for SHP, etc..

## 2. Technical Achievements

### 2.1 Research on Framework System of SHP Technical Standards in South Asia

(1) Research on framework system of standards

At present, in terms of the standard framework system research, the project team has completed the research work such as the comparative study of international standards for small hydropower, and the standard system and management of small hydropower in China. The



project team conducts a review and comparative study of international standards of small hydropower based on the standards of major countries or regions in the development of small hydropower. Meanwhile, it summarized technical standard system and the management experience of small hydropower in China, and combined with the experience of international standards to put forward framework suggestions for the establishment of small hydropower standard system in South Asia.

Through expert consultation, information retrieval and so on, the project team has collected technical standards, manuals, and guidelines related to small hydropower in typical countries or regions, covering those with abundant small hydropower resources, advanced technology, and more practices, such as China, the European Union, Japan, India, the United States, the World Bank, the World Hydropower Association, etc. The project team selected several typical and regionally representative standard systems for detailed comparison, and at the same time discussed and analyzed hydropower sustainability specifications in part. Through comparison, the commonality and characteristics are analyzed, and the applicable scope of relevant regulations is determined, which provides reference for the construction of small hydropower technical standards in South Asia.

### **2.2 Joint Research on Centralized Control Technology for Optimal Operation of Multiple SHP Stations**

Optimal dispatch refers to using the system engineering optimization method to process the water flow dispatch problem of the reservoir into a system engineering optimization problem, and using the optimization technology to make the optimal decisions for the reservoir, so that the reservoir can obtain the maximum operation benefit. The joint optimal scheduling of reservoir and the reservoir groups is a systematic project. With respect to the optimal scheduling, the system analysis method is to be applied according to the principle of systems engineering, the optimal model is to be established for the operation of each reservoir, and based on meeting the requirements for reservoir operation, such as the water level, the discharge, and the output, etc., the objective function is to be determined and the optimization algorithm to be used to solve the problems, so as to achieve the overall optimization. In 2021, the project team completed the construction of the simulation model for the optimal operation of the power generation system of several small hydropower stations in the basin, and at present is currently studying and determining the optimal scheduling operation scheme and remote centralized control scheme under the multi-objective constraints.

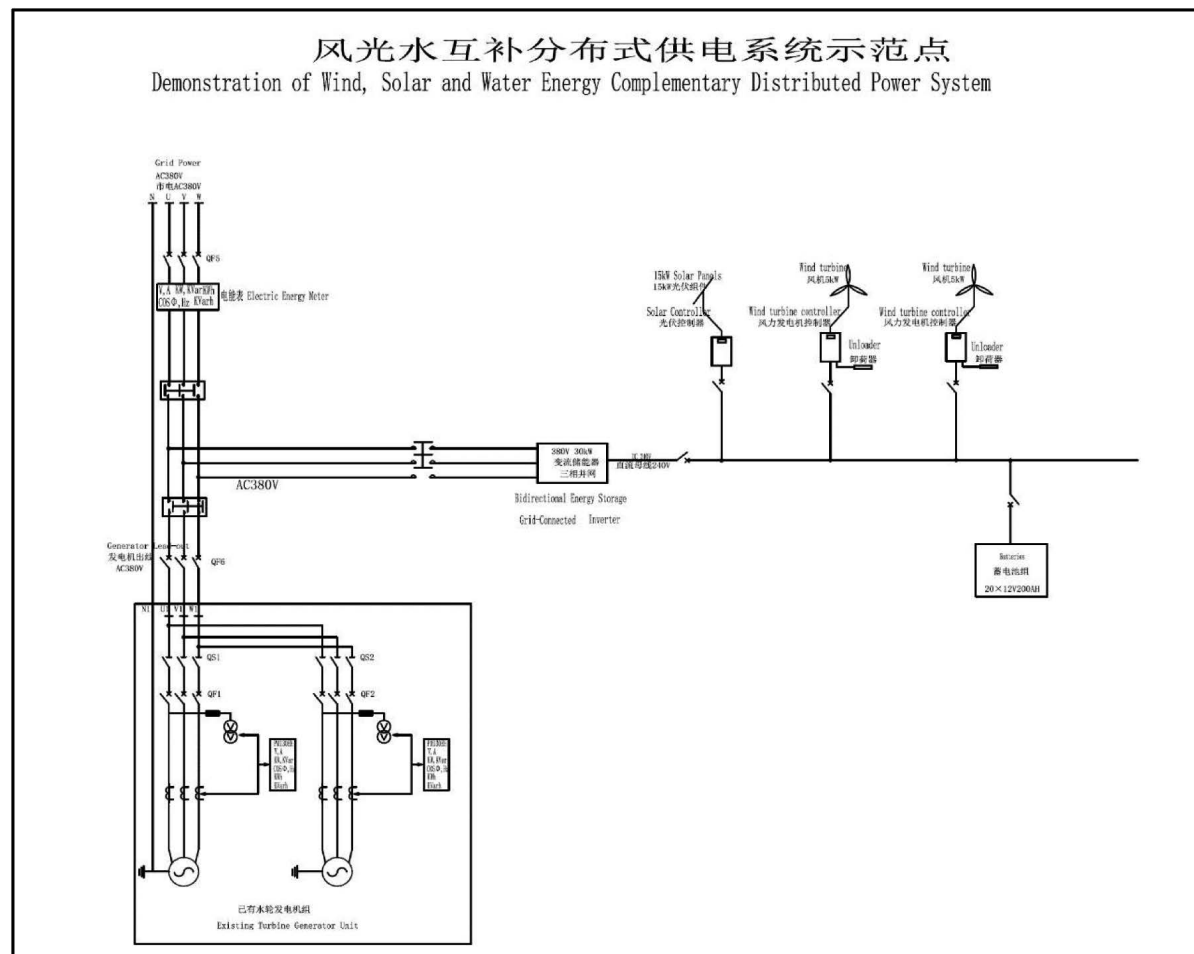
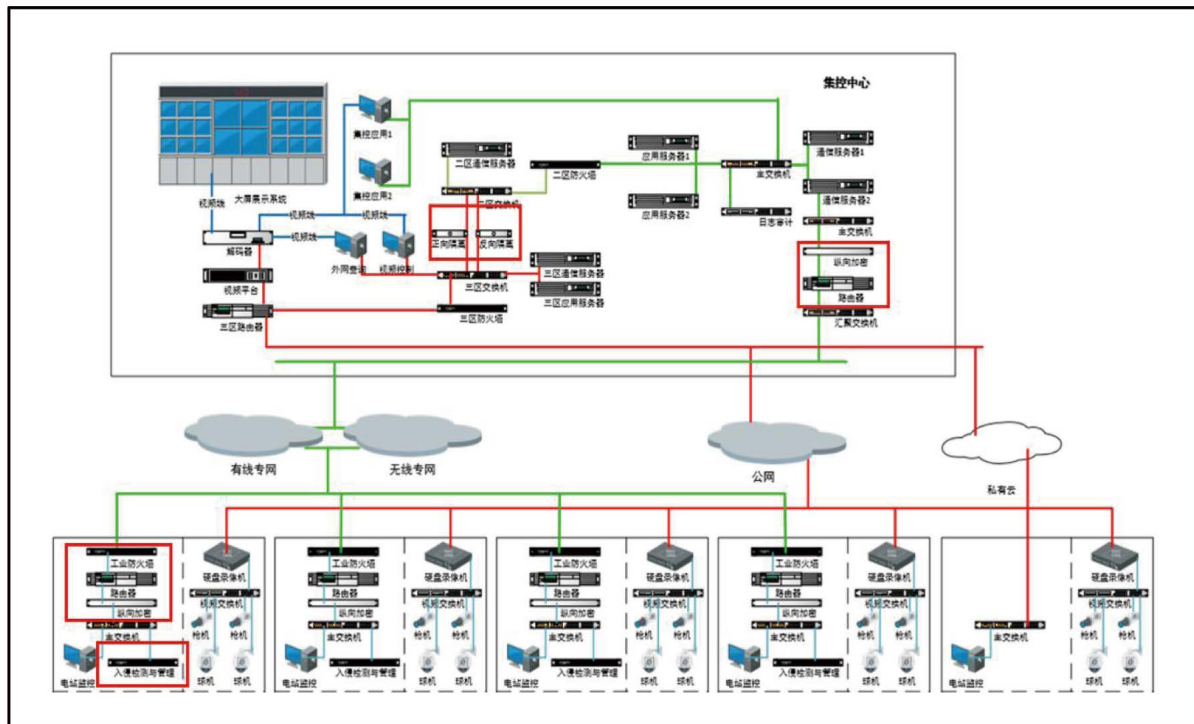
The optimal scheduling of small hydropower stations in a basin is a typical multi-constraint optimization problem, which can be solved theoretically by the mathematical optimization method. After the simulation model is established, whether the solution method is suitable or not has a certain influence

on the operation results. According to the actual situation, it is very important to choose a solution method that is more practical and can meet the scheduling needs. Therefore, for this project, the joint solution algorithm of dynamic programming and discrete differential dynamic programming is adopted to solve the proposed scheduling model.

### **2.3 Joint Research on Stability of Off-grid Hybrid Power Generation System based on SHP**

With the strong support of the Pakistani colleagues, the project team compiled the Special Report on Renewable Energy and Electricity Load Analysis in Pakistani Mountainous Areas, and built a simulation platform on this basis. The simulation research on the stability of hybrid power generation under different situations and based on different resources of wind, solar and water has been carried out and the simulation report was completed, which lays a solid foundation for the follow-up research work on the variable current energy storage technology, and the automatic voltage and frequency regulation of the isolated grid and the off-grid wind-solar-water hybrid power generation system based on small hydropower.

The project team analyzed the overall national energy resources and development in Pakistan. Meanwhile, focusing on the northern mountainous areas, the development of renewable energy in the region was studied, and the population distribution and power grid coverage





in the northern mountainous areas were analyzed. The load status was investigated to provide data support for the subsequent relevant units or organizations to design and construct renewable energy power stations, such as wind, solar and water projects, in the local area. After analyzing the potential of wind, solar, water and other natural resources, the power grid coverage, and the user load characteristics in mountainous areas in northern Pakistan, the project team selected the area near the demonstration station as the research object, and conducted a modeling and simulation study on a hybrid power generation system. In the next step, based on the simulation data, the project team will further study the complementary and adaptive power generation method of hybrid system, the PCS energy storage technology and the automatic voltage and frequency regulation mode of isolated grid.

## 2.4 Equipment Trial Production and Demonstration of SHP and other Renewable Energy

(1) Technical demonstration of centralized control technology for optimal operation of multiple small hydropower stations

After the communication and coordination between Chinese project team members and the foreign partners, the Cascade I and Cascade II of Rangar hydropower project are selected as the demonstration stations of centralized control technology, which are located in Rangar Township, Rawalacot City, Kashmir, northern mountainous

region in Pakistan. At present, both the implementation plan and the main design scheme of the demonstration stations have been completed. The following figure shows the overall technical solution of the centralized control for the optimal operation of multiple small hydropower stations.

(2) Technical demonstration of off-grid hybrid power generation system based on SHP

After taking the future operation and maintenance into consideration, the Cascade II of Rangar hydropower project in Rangar Township, Rawalacot City has been selected as the demonstration station of off-grid hybrid power generation system. Both the implementation plan and the main design scheme of the demonstration station have been completed.

## 2.5 Platform Building on China-Pakistan Joint Laboratory for Small Hydropower

The construction of the laboratory platform is divided into two parts, which are to be completed respectively in China and Pakistan. The laboratory in China is located at 228, Yanshan Road, Dongzhou Street, Fuyang District, Hangzhou, which has two buildings. The solar photovoltaic panels and wind turbine equipment are installed on the roof of Building No. 1, occupying an area of 48m×10m on the roof. The demonstration system of micro hydropower, as well as the control room and the exhibition hall are constructed in Building No.2. The construction plan of the laboratory is composed of the following steps. i.e. civil foundation excavation for power generation units,

foundation reinforcement, concrete pouring, installation of overall steel structure, installation of mechanical equipment of turbine-generator units, installation of electrical equipment of turbine-generator units, installation of wind-solar power generation system, cable laying, cable connection, commissioning and trial operation.

The laboratory in Pakistan is located in the site of PCRET, Islamabad, the capital city of Pakistan, which is a 2-story building with a floor space of 50m×15m. The first floor is the exhibition area for turbine-generator units and control equipment, the second floor for overhaul and storage, and the roof for equipment of solar power and wind power, which totally covers an area of 1000m<sup>2</sup>. The construction plan is similar to that of the one in China.

In order to better manage and maintain the laboratories in China and Pakistan, the *Joint Laboratory Development Plan*, the *Joint Laboratory Operation Mechanism* and other related documents were formulated as reference manuals for laboratory management.

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# HRC's Annual Report on Foreign Affairs in 2021 and Work Plan for 2022

*National Research Institute for Rural Electrification (NRIRE)  
Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (HRC)*

In 2021, HRC seriously studied and earnestly implemented Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, and the spirit of the Sixth Plenary Session of the 19<sup>th</sup> CPC Central Committee. Based on an accurate understanding of the new stage of development, with a view to fully implementing the new development philosophy and accelerating our efforts to create a new development dynamic, and led by the Ministry of Water Resources (MWR) of the People's Republic of China and Nanjing Hydraulic Research Institute (NHRI), HRC spared no efforts in 2021 to overcome the impact of the pandemic, innovate the China-aid training models, conduct the international trainings and seminars, continuously promote the overseas technology transfer centers and extensively open up overseas markets, which have yielded fruitful results in all respects.

## **I S u c c e s s f u l Transformation of China-aid Trainings**



**Ministerial Workshop on Water Resources Management and Socioeconomic Development for Developing Countries**

In order to enhance China-aid human resources development, deepen South-South Cooperation and promote exchange and cooperation among developing countries, especially the BRI countries, in the fields of water resources management, small hydropower and other clean energy, rural electrification, etc. and strengthen mutual understanding and enhance traditional friendships, HRC has played an active role in implementing China-aid trainings for developing countries. Not only

did HRC overcome the difficulties such as the impact of the pandemic, the large time zone difference among participating countries, the large number of online participating countries, etc., but also HRC explored new forms of online training and developed diverse online courses. In this context, a total of 9 online training programs were successfully organized, among which were one ministerial workshop for developing countries, one seminar for Latin America and the Caribbean (LAC) with Spanish as the working language,





on the themes of “Green Economy and Environmental Protection” and “Flood and Hydrological Forecasting and Warning” were conducted for the first time, and HRC continued to organize bilateral training courses on small hydropower technologies and construction and management of water conservancy and hydropower projects respectively for Rwanda and Nigeria. A total of 995 participants of government officials and technicians from 56 countries attended the trainings, seminars and workshops. Both the numbers of participating countries and the quantity of participants hit a record high.

Through vigorously carrying out online China-aid trainings, HRC has kept close contact and exchanges with massive developing countries and continuously expanded exchange channels to further strengthen friendship and mutual trust, laying a good foundation for both bilateral and multilateral international cooperation in the future.

## II In-depth Exchanges and Discussions

In the past year, HRC organized the International Forum on Green Energy and Climate Change for BRI Countries, Online Seminar on Renewable Energy Cooperation with Training Alumni of HRC and China-Pakistan Forum on Standard for Small Hydropower Technology. HRC also participated in organizing the Seminar on Joint Construction of Standards for Green Hydropower Technology for Lancang-Mekong Countries, Webinar on Dam Safety

**Seminar on the Exploitation & Utilization of Water Resources and the Treatment of Aquatic Environment for Latin America, Caribbean and South Pacific**

and one seminar for Francophone African countries with French as the working language. In addition, training programs



**Seminar on Small Hydropower Technology for Rwanda**



**Seminar on Electrification Mode based on Clean Energy for Belt...**

2021/09/14 00:00 - 2021/09/30 23:59

National Research Institute for Rural Electrification /

HRC

September 15

**Presentation 1: The Key to China's Success in Fighting...**  
Online 249  
2021/09/15 00:00 - 23:59

**Presentation 2: China in Brief**  
Online 112  
2021/09/15 00:00 - 23:59

September 16

September 17

**Presentation 4: A General Survey of Small Hydropowe...**  
Online 117

**Online Training Management Platform**

Management under the project of “Construction and Demonstration on Dam Safety Supporting System for ASEAN Countries”, the Session 6 of the 2<sup>nd</sup> Lancang-Mekong Water Resources Cooperation Forum, with

### Training Programs Organized by HRC in 2021

No.	Project Title	Date/Days	Number of Countries	Number of Participants
1	Seminar on the Exploitation & Utilization of Water Resources and the Treatment of Aquatic Environment for Latin America, Caribbean and South Pacific	14 <sup>th</sup> -27 <sup>th</sup> July 14 Days	6	168
2	Seminar on Small Hydropower and Rural Electrification for Francophone African Countries	25 <sup>th</sup> Aug.-7 <sup>th</sup> Sept. 14 Days	11	94
3	Seminar on Electrification Mode Based on Clean Energy for BRI Countries	15 <sup>th</sup> -28 <sup>th</sup> , Sept. 14 Days	18	86
4	Training Course on Flood and Hydrological Forecasting and Warning for Developing Countries	13 <sup>th</sup> Oct.-2 <sup>nd</sup> Nov. 21 Days	20	95
5	Ministerial Workshop on Water Resources Management and Socioeconomic Development for Developing Countries	21 <sup>st</sup> -27 <sup>th</sup> , Oct. 7 Days	16	100
6	Seminar on Small Hydropower and Sustainable Development of Rural Communities for Developing Countries	26 <sup>th</sup> Oct.-8 <sup>th</sup> Nov. 14 Days	25	133
7	Seminar on Green Economy and Environment Protection for Developing Countries	3 <sup>rd</sup> -16 <sup>th</sup> Nov. 14 Days	19	98
8	Seminar on Construction and Management of Water Conservancy and Hydropower Project for Nigeria	9 <sup>th</sup> -22 <sup>nd</sup> Nov. 14 Days	1	84
9	Seminar on Small Hydropower Technology for Rwanda	22 <sup>nd</sup> Nov.-16 <sup>th</sup> Dec. 25 Days	1	137





**2<sup>nd</sup> Lancang-Mekong Water Resources Cooperation Forum**

the topic of “Sustainable Hydropower Development and Energy Security”, the 1<sup>st</sup> China-ASEAN Dam Science Popularization Contest, 2021 International Youth Forum on Hydrology and Water Resources,

Webinar on Water Safety of UNICEF: Sharing Experience and Practices of Water Supply and Safety in China and Mekong Countries. Besides, HRC dispatched delegates to attend the second Belt and Road Ministerial

Meeting on Energy, China-Uruguay Seminar on Water Resources Technology, China-Europe Webinar on Policy Dialogue, the Inaugurating Meeting of Overseas Branch of the China Society for Hydropower Engineering, etc. In order to promote and propagandize international cooperation, HRC published special columns in domestic and international newspapers including China Water Resources, Vientiane Times, Phnom Penh Post, etc. Through organizing or attending these activities, HRC carried out extensive and intensive technical exchanges on green energy, climate change, water management, dam safety, etc., in a bid to share ecological and sustainable development concepts and experiences, help to improve local livelihoods, and advance towards the goals of “emission peak, carbon neutrality” and the economic, social and environmentally sustainable



**China-ASEAN Dam Science Popularization Contest**



**Design and Supply of Equipment for a Low-head Run-of-the-river Demonstrative Hydropower Station in Serbia**

development.

### **III Further Construction of Overseas Centers**

HRC maintains close contact with the counterparts in different countries where HRC's four overseas centers are located and keeps pushing forward the construction of overseas centers. In this context, HRC has completed the key project of Strategic International Sci.-tech Innovation Cooperation and of Intergovernmental Sci.-tech Innovation Cooperation under China's National Key R&D Programs (NKPs). China-Pakistan Joint Laboratory for Small Hydropower under the Belt and Road Initiative has made considerable progress. The framework of small hydropower technical standards applicable to South Asia countries has been initially set up. Additionally, HRC also developed a talent exchange and training

program on small hydropower and renewable energy technologies, and jointly cultivated 10 young hydropower professionals for South Asia countries. Besides, HRC carried out research on the off-grid hybrid power generation technology and the remote centralized control technology for small hydropower stations by organizing technical seminars, making remote technical investigations and selecting potential demonstrative sites. And HRC promoted the construction of demonstrative power plants in ASEAN countries and the China-ASEAN Technology Transfer and Training Center on Renewable Energy and Rural Electrification, further boosting the research and application of solar-powered water pumping system used for irrigation. Considering the crop planting and actual irrigation demand in different parts of the countries, for instance, the Philippines, HRC researched on some of the applicable technologies

including solar inverter optimization, water-saving irrigation technology, smart water allocation technology, etc. Under the China-Europe Water Platform (CEWP), HRC further strengthened technical exchanges and cooperation via videoconferencing with the University of Belgrade, Serbia, and the University of Natural Resources and Life Sciences, Vienna, Austria, and renewed the Memorandum of Understanding on cooperation between two Parties. On the basis of the cooperative project of Sustainable Hydropower Use and Integration in China and Europe (SHUI-ChE) under the framework of the China-Europe Water Platform (CEWP), HRC further planned for the program of joint research on Watershed-scale Impact Assessment and Response Strategy of Hydroelectric Power on River Ecosystems. Under the framework of the Technical Transfer, Research and Training Center on Clean Energy





**Instructions on the Installation of Mayari Hydropower Plant in Cuba**

and Rural Electrification for Africa, HRC has been conducting multilateral exchanges and training courses, and promoting the localization of talent training in the field of small hydropower development, renewable energy technology and water management and hydropower project management in Ethiopia, Rwanda and Nigeria.

#### **IV Extensive Industrial Capacity Cooperation**

Taking full advantage of China-aid trainings, international scientific and technological cooperation, the platform of HRC's overseas centers, as well as its function as a "window" to the outside world, HRC has been offering wide-ranging services including hydropower engineering consultation, equipment supplies, installation and testing, solar power and hybrid power generation system, etc. with a view to extending

international cooperation in industrial capacity. Besides, HRC completed the equipment supply and on-site installation of the solar-powered water pumping systems in Rwanda, finalized the construction and assisted the plant owner for the commissioning of Batu Gajah hydropower plant in Indonesia, as well as offered on-site installation instruction to Mayari Hydropower Station in Cuba. HRC is also engaged in the China-aid supply of solar systems to countries including Mali, Sudan, etc. and the spare parts supply to hydropower plants in Turkey, Peru and Kenya. Based on the demonstrative achievement of the previous solar-powered irrigation projects, HRC further expanded solar-powered water pumping system for irrigation, water purification system and rooftop solar power projects in the Philippines. Hangzhou Yatai Hydro Equipment Completing Co., Ltd., subordinate to HRC, signed strategic cooperative agreements respectively with

ENSOPHX (Tianjin) International Engineering Consulting Co., Ltd. and China Energy Engineering Group Jiangsu Power Design Institute Co., Ltd., with a view to jointly exploring the markets of small hydropower and hybrid power generation in Southeast Asia, South Asia and the Middle East, and meanwhile Hangzhou Yatai Hydro Equipment Completing Co., Ltd. offered design and consultation services to overseas hydropower projects undertaken by Sinoma Energy Conservation Limited, China's Hydropower Thirteenth Bureau Hydropower Engineering Co., Ltd., Jiangsu Power Design Institute Co., Ltd., Shanghai Investigation, Design & Research Co., Ltd., Jiangxi Water and Hydropower Construction Group Co., Ltd., etc.

#### **V Broadened Channels of Information Exchange**

HRC completed the publication of important information in English and Chinese on the website and revised the English textbook *Small Hydropower Technology in China*. Besides, HRC signed a cooperation agreement with the School of Foreign Languages, Zhejiang University City College, and exchanges on cooperation of the trainings and studies of foreign students in China. The information exchange channels and the international cooperation and exchange continued to be broadened and promoted.

#### **VI Work Plan for 2022**

1. To improve training contents



and innovate training mechanisms

HRC will continue to improve the design of training courseware, make video tutorials, carry out “Internet Plus” online education programs, expand the application of VR technology, and set up the new training models incorporating both online and offline courses to successfully complete various training courses and workshops. Besides, HRC will also cooperate with other organizations to strengthen the faculty, enrich the contents of teaching materials and expand the training areas, and will make full use of computers science and mobile terminals to achieve scientific management of China-aid training.

2. To strengthen the construction of the four overseas centers based on the domestic and international cooperation platforms

HRC will strengthen the construction of the International Talent Training Base for Green Hydropower and the China-Pakistan Joint Laboratory for Small Hydropower under the Belt and Road Initiative, and will accelerate the implementation of key projects of Strategic International Sci.-tech Innovation Cooperation and of Intergovernmental Sci.-tech innovation cooperation under the National Key R&D Programs, the China-ASEAN Maritime Cooperation Fund Program and the Pérez-Guerrero Trust Fund (PGTF) project of G77. Moreover, HRC will also actively apply for the key project of Strategic International Sci.-tech Innovation Cooperation and of Intergovernmental Sci.-tech Innovation Cooperation under the National Key R&D

Programs from the Ministry of Science and Technology, the Asian Cooperation Fund project, etc. It will continue to promote the cooperation with the South Asian countries concerning small hydropower standards, hybrid power generation system and centralized control technologies and Sino-Austrian inter-governmental scientific and technological cooperation, China-Europe cooperation on water resources and the third-party market cooperation. HRC will also carry out renewable energy technology transfer and capacity cooperation with the ASEAN Energy Centre, and will build the regional sub-centers of the China-Africa Technology Transfer, Research and Training Center on Clean Energy and Rural Electrification. Focusing on the “Emission Peak, Carbon Neutrality” objective, HRC will strengthen green and low-carbon oriented exchanges with developing countries on green energy technologies such as hydropower, wind power, solar energy, etc. and will deepen bilateral and multilateral cooperation in capacity building, joint research, project demonstration and technology transfer in an effort to promote green energy interconnection and facilitate energy transformation and sustainable development in the BRI countries.

3. To focus on priority countries and areas to expand overseas markets

Based on the role of the Green Energy Working Group of the Belt and Road Energy Partnership Cooperation Network, HRC will keep close contact with the training fellow alumni of HRC and further explore market potential. It will cooperate

with the large state-owned enterprises to provide technical services. Based on the international scientific and technological cooperation and the platforms of overseas centers, it will build the domestic and international teams and set up a new operation mode to promote the clean energy and rural electrification technology transfer and international cooperation in industrial capacity under the Belt and Road Initiative. It will focus on developing hydropower and solar energy projects in Indonesia, the Philippines, Vietnam, Mongolia, Uzbekistan, Kenya, Rwanda, Zimbabwe, etc.

4. To establish incentive mechanisms and strengthen talents cultivation

HRC will improve the system, establish an incentive mechanism, clarify position responsibilities and strengthen talents training. More trainings and exchanges will be organized to boost technical, commercial and managerial capabilities and improve market expansion skills. It will also strengthen project management to ensure the safety of projects and personnel and continue to assist in the article submission, translation and publication of the two HRC journals, the newsletters and the website of HRC, as well as the Zhejiang Foreign Affairs Yearbook and the magazine of China South-South Cooperation Network, broadening the channels of contact and communication to strengthen the information sharing and technology promotion.

(Source: HRC)■

# A Review of the International Training Programs in 2021

*National Research Institute for Rural Electrification (NRIRE)  
Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (HRC)*

*TANG Yanqiu, ZHANG Hua*

**N**ational Research Institute for Rural Electrification, MWR (NRIRE), also called Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (briefed as HRC), is an international regional organization which was established in November, 1981 with the co-sponsorship of Chinese Government and UN organizations including UNDP and UNIDO. As a research, training, information and consultation organization for SHP in the Asia-Pacific region and the world, HRC serves as an important window for international cooperation in SHP field.

HRC is the only specialized research institute of rural hydropower and electrification in China. It is also the Research Center on Hydropower Engineering Technology of the Ministry of Water Resources, the designated training organization for national water conservancy industry, International Science and Technology Cooperating Base of Renewable Energy and Rural

Electrification in Zhejiang Province, and International Training Base for Green Hydropower Personnel, as well as the only organization in the water conservancy system that directly undertakes the China-aid training programs sponsored by the Ministry of Commerce.

HRC has taken an active role in undertaking the China-aid training programs, carrying out international cooperation on science and technology, setting up overseas technical transfer center, holding international conferences and implementing multilateral and bilateral technical exchanges. HRC is awarded as “Family of SHP in the World” by the international community, and “Model of South-South Cooperation” by the Ministry of Commerce. Since 1983, entrusted by Ministry of Water Resources, Ministry of Commerce, Ministry of Science and Technology, Ministry of Foreign Affairs, National Development and Reform Commission, China International Development Agency and UN organizations etc., HRC has

successfully organized both at home and abroad in total 129 seminars, training courses and workshops, which have embraced 3875 participants from 123 countries.

In 2021, under the careful guidance of the Department of International Cooperation, Science and Technology of the Ministry of Water Resources, the Training Center of the Ministry of Commerce and the Nanjing Hydraulic Research Institute, HRC strived to overcome the impact of the Covid-19, actively explored new online training models. With the support and assistance of Human Resources Training Base for Belt & Road Initiative of the Ministry of Water Resources, International Center on Small Hydro Power, Nanjing Research Institute of Hydrology and Water Conservation Automation of the Ministry of Water Resources, Zhejiang College of Construction, etc., HRC has undertaken 9 online training programs, including Seminar on the Exploitation and Utilization of Water Resources and the Treatment of Aquatic Environment

for Latin America, Caribbean and South Pacific, Seminar on Small Hydropower and Rural Electrification for Francophone African Countries, Seminar on Electrification Mode based on Clean Energy for BRI Countries, Training Course on Flood and Hydrological Forecasting and Warning for Developing Countries, Ministerial Workshop on Water Resources Management and Socioeconomic Development for Developing Countries, Seminar on Small Hydropower and Sustainable Development of Rural Communities for Developing Countries, Training Course on Construction and Management of Water Conservancy and hydropower for Nigeria, Seminar on Green Economy and Environment Protection for Developing Countries and Seminar on Small Hydropower Technology for Rwanda. A total of 995 participants attended the

9 training programs, including 2 ministerial officials namely H.E. Mr. Kefentse Chewingie Mzwinila, Honorable Minister of Ministry of Land Management, Water and Sanitation Services of Botswana, and H.E. Mr. Randy Rodríguez, Vice Minister of the Ministry of Water Resources of Venezuela.

### **I Seminar on the Exploitation and Utilization of Water Resources and the Treatment of Aquatic Environment for Latin America, Caribbean and South Pacific**

From July 14<sup>th</sup> to 27<sup>th</sup>, 2021, the “Seminar on the Exploitation and

Utilization of Water Resources and the Treatment of the Aquatic Environment for Latin America, Caribbean and South Pacific” was successfully held. 168 representatives from Colombia, Dominica, Ecuador, Mexico, Peru and Venezuela respectively have signed up to participate in this seminar. Under the careful guidance and strong support of the Ministry of Commerce and the Ministry of Water Resources, the 14-day training program achieved complete success and yielded fruitful results. Mr. Chen Runyun, Vice President of Academy for International Business Officials (AIBO) of the Ministry of Commerce of China had attended the opening ceremony. He emphasized that China will always commit to the path of peaceful development and mutual benefits, and is willing to share the experience of development and propose international cooperation





programs via talent training and technical exchange. China fully supports Latin American countries in their capacity building for self-development. During the seminar, participants gained an in-depth understanding of China's advanced concepts, management experience and concrete practices in the development and utilization of water resources

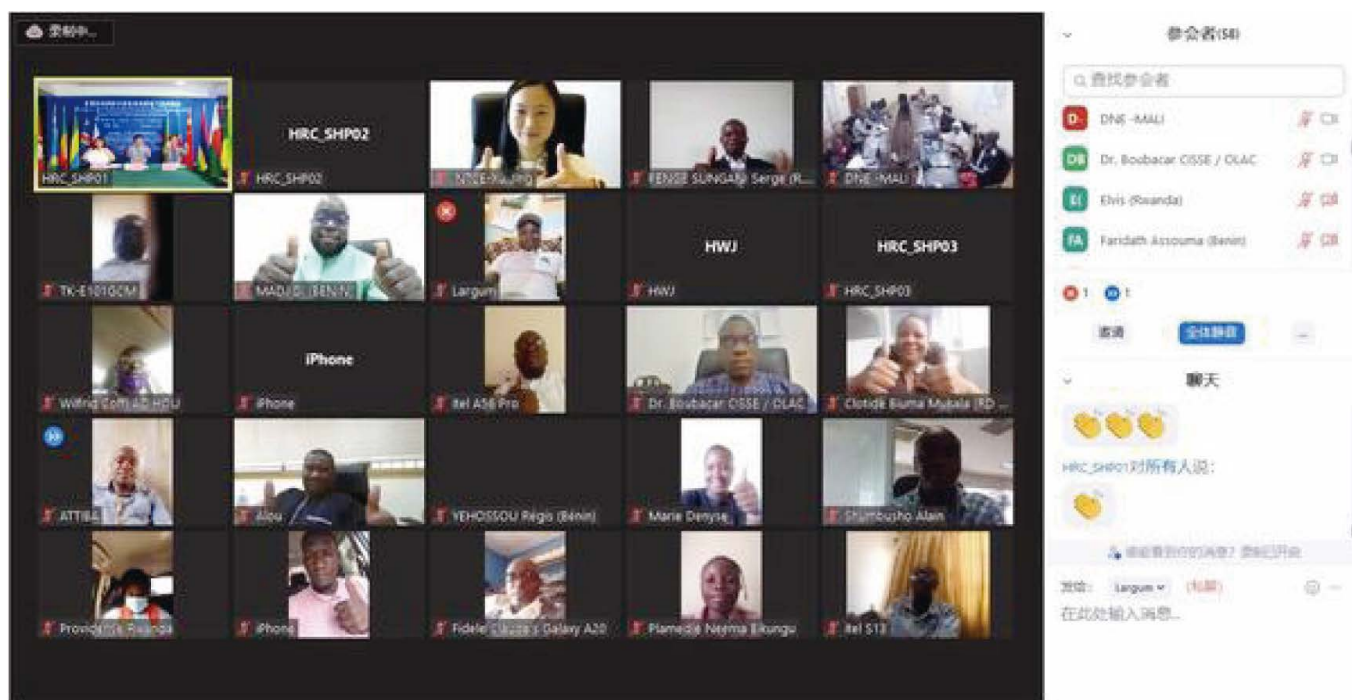
and water environment management. Moreover, participants had several virtual tours to some of China's most typical water projects and water research institutes. This seminar is the 121<sup>st</sup> international training program that HRC had implemented since its establishment. It is also HRC's first online training seminar that had taken place since the pandemic

of Covid-19. HRC attached great efforts in preparing this seminar and had come up with several ideas to solve problems that emerged in the implementation, such as the effective coordination among a vast number of participants and the large timezone difference, etc. HRC is now trying to explore new modes for online international training programs and has been constantly accumulating and enriching the experience.

## II Seminar on Small Hydropower and Rural Electrification for Francophone African Countries

From August 25<sup>th</sup> to September 7<sup>th</sup>, 2021, the "Seminar on Small Hydropower and Rural Electrification for Francophone African Countries" was successfully held online. 94 officials from 11 francophone African Countries including Algeria, Benin, Central African Republic, Democratic Republic of the Congo, Gabon, Madagascar, Mali, Mauritius, Rwanda, Senegal and Tunisia participated in the online seminar. Ms. Xu Jing, Deputy Director General, International Economic & Technical Cooperation and Exchange Center, Ministry of Water Resources, P. R. China was present at the opening ceremony and delivered the speech. During the seminar, a series of technical presentation, virtual tours, and cultural experience had been carried out in the field of small hydropower and rural electrification, which gained remarkable results. All

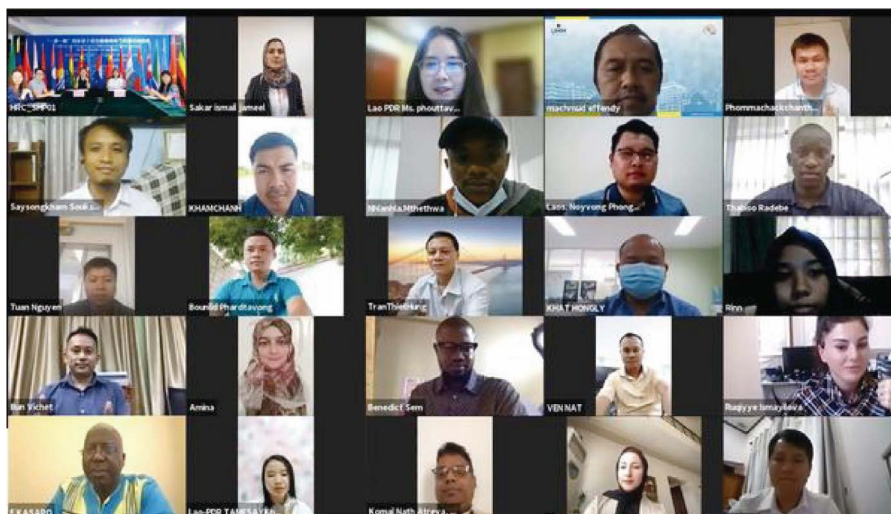




the participating countries expressed their willingness to carry out in-depth cooperation and extensive exchange with China in the future, and also expected to carry out more productive cooperation with HRC.

### III Seminar on Electrification Mode based on Clean Energy for Belt and Road Countries

From 15<sup>th</sup> to 28<sup>th</sup> September, 2021, the “Seminar on Electrification Mode Based on Clean Energy for Belt and Road Countries” was held online with full success. The 14-day seminar was aimed at the extensive exchange and sharing of the proven technology and the management practice in the field of clean energy and rural electrification via presentations, online visits and discussions. 86 officials from 18 countries, including







Azerbaijan, Cambodia, Ghana, Indonesia, Iraq, Kiribati, Laos, Mongolia, Morocco, Nepal, Pakistan, South Africa, Tunisia, Uzbekistan, Venezuela, Vietnam, Zambia and Zimbabwe attended the seminar. The seminar provided a platform for the countries along the Belt and Road to fully discuss and communicate in

the field of rural electrification and clean energy, aiming to strengthen multilateral cooperation and promote the common development of countries along the Belt and Road.

#### IV Training Course on Flood and Hydrological

#### Forecasting and Warning for Developing Countries

From October 13<sup>th</sup> to November 2<sup>nd</sup>, 2021, the “Training Course on Flood and Hydrological Forecasting and Warning for Developing Countries” was successfully held.







95 participants from 20 countries, including Afghanistan, Algeria, Angola, Egypt, Cambodia, Kiribati, Malaysia, Myanmar, Philippines, Laos, Nepal, Pakistan, Seychelles, Sri Lanka, Thailand, Tanzania, Uzbekistan, Venezuela, Vietnam, Zambia, etc. attended the training. During the 21-day training course, 16 experts from Development Research Center of the State Council, China Academy of Chinese Medical Sciences, Hohai University, Nanjing Hydraulic Research Institute, National Research Institute for Rural Electrification, China Hydrology of the Huaihe River Commission, etc. came to deliver the special reports, publicizing the technology development in China. The participants took active part in the training and exchanged a lot to strengthen the specific knowledge and

skill, so as to promote the exchange on technology and cooperation. The professional presentations by all the experts also received unanimous praise.

### **V Ministerial Workshop on Water Resources Management and Socioeconomic Development for Developing Countries**

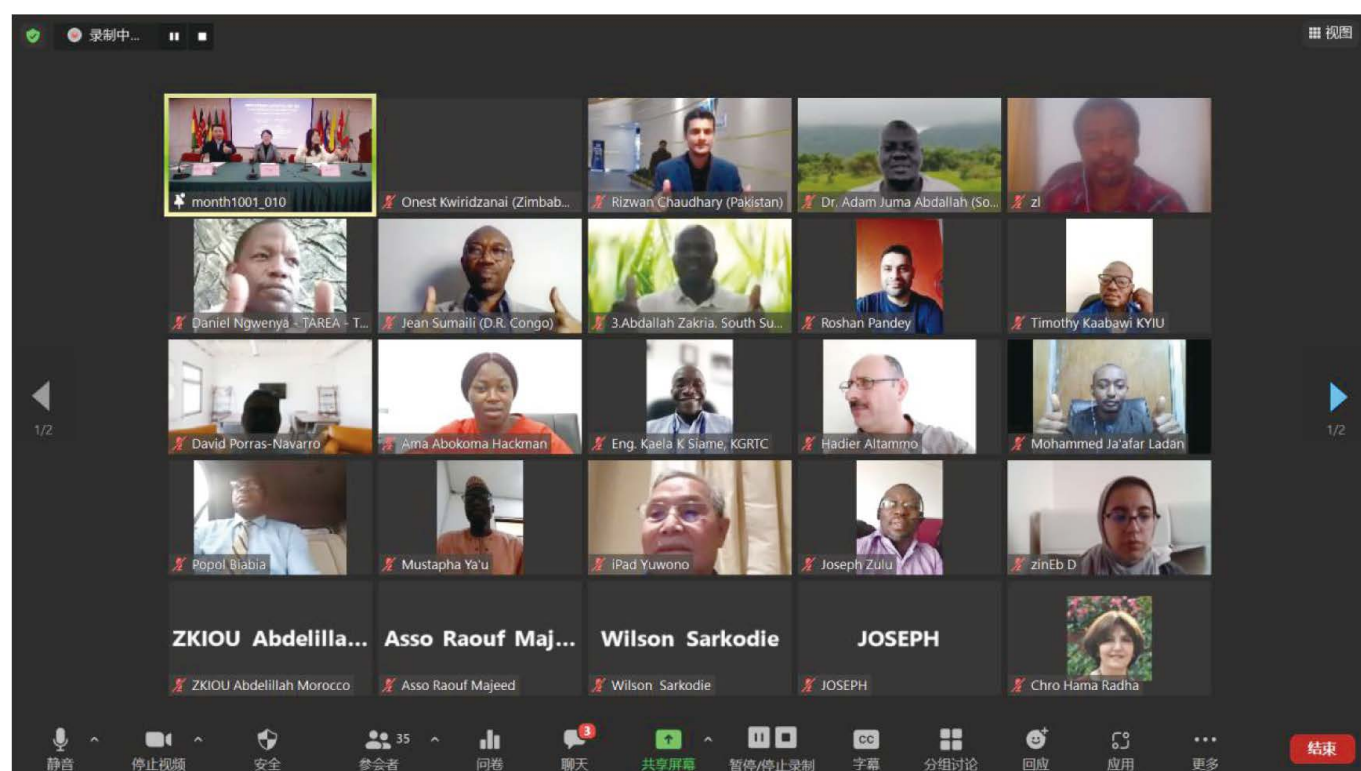
From 21<sup>st</sup> to 27<sup>th</sup> October, 2021, the “Ministerial Workshop on Water Resources Management and Socioeconomic Development for Developing Countries” was held online with full success. Mr. Li Ge, Deputy Director General, Department of International Cooperation, Science

and Technology of the Ministry of Water Resources, P. R. China, was presented at the opening ceremony and delivered a keynote report titled “Water Resources of China”. H.E. Mr. Kefentse Chewingie Mzwini, Honorable Minister of Ministry of Land Management, Water and Sanitation Services of Botswana and other one hundred senior officials and experts in the field of water resources management and socioeconomic development took part in the significant event. The one week workshop was implemented by means of presentations, online visits and discussions. Mr. Zhang Jinayun, the academician of Chinese Academy of Engineering, Mr. Chen Mingming, the former Chinese ambassador to New Zealand and the Cook Islands, and Sweden, the experts from the Institute of Hydroecology, Ministry

of Water Resources and Chinese Academy of Sciences, the Water Development Planning & Research Center of Zhejiang Province, and

the Construction and Administration Bureau of South-to-North Water Diversion Middle Route Project were invited to deliver presentations.

Online visits were paid to National Water Museum of China, Water Conservancy System at Liangzhu Ancient City, and Yucun Village





with green development, etc. The workshop established a platform to promote the policy communication and exchange among minister-level and senior officials and experts in the field of water resources, and more concrete cooperation would be implemented to promote the sustainable socioeconomic development in all the participating countries.

## VI Seminar on Small Hydropower and Sustainable Development of Rural Communities for Developing Countries

From 26<sup>th</sup> October to November 8<sup>th</sup>, 2021, the “Seminar on Small

Hydropower and Sustainable Development of Rural Communities for Developing Countries” was successfully held online. More than 70 officials, technical experts and enterprise representatives from 26 Asian, African and Latin American countries, including Azerbaijan, Zambia, Mexico, etc., attended the seminar. In addition, over 50 experts from several developing countries were invited to participate in this event. Participants listened to the presentations covering the topics such as small hydropower technology, small hydropower development in developing sustainable economic and social development in rural areas, and international cooperation on small hydropower development were delivered and online visits to National Water Museum of China, NARI

Group Corporation, Tianhuangping Pumped Storage Power Plant were also arranged. During the seminar, representatives from 7 countries includes Democratic Republic of the Congo, Morocco, Zimbabwe, Rwanda, Madagascar, Iraq, and Nepal introduced the development of small hydropower, photovoltaic, wind energy and other renewable energy, as well as the condition of the power systems in their respective countries, and communicated with Chinese experts on the future cooperation.

## VII Seminar on Green Economy and Environment Protection for Developing Countries

From 3<sup>rd</sup> to 16<sup>th</sup> November, 2021,





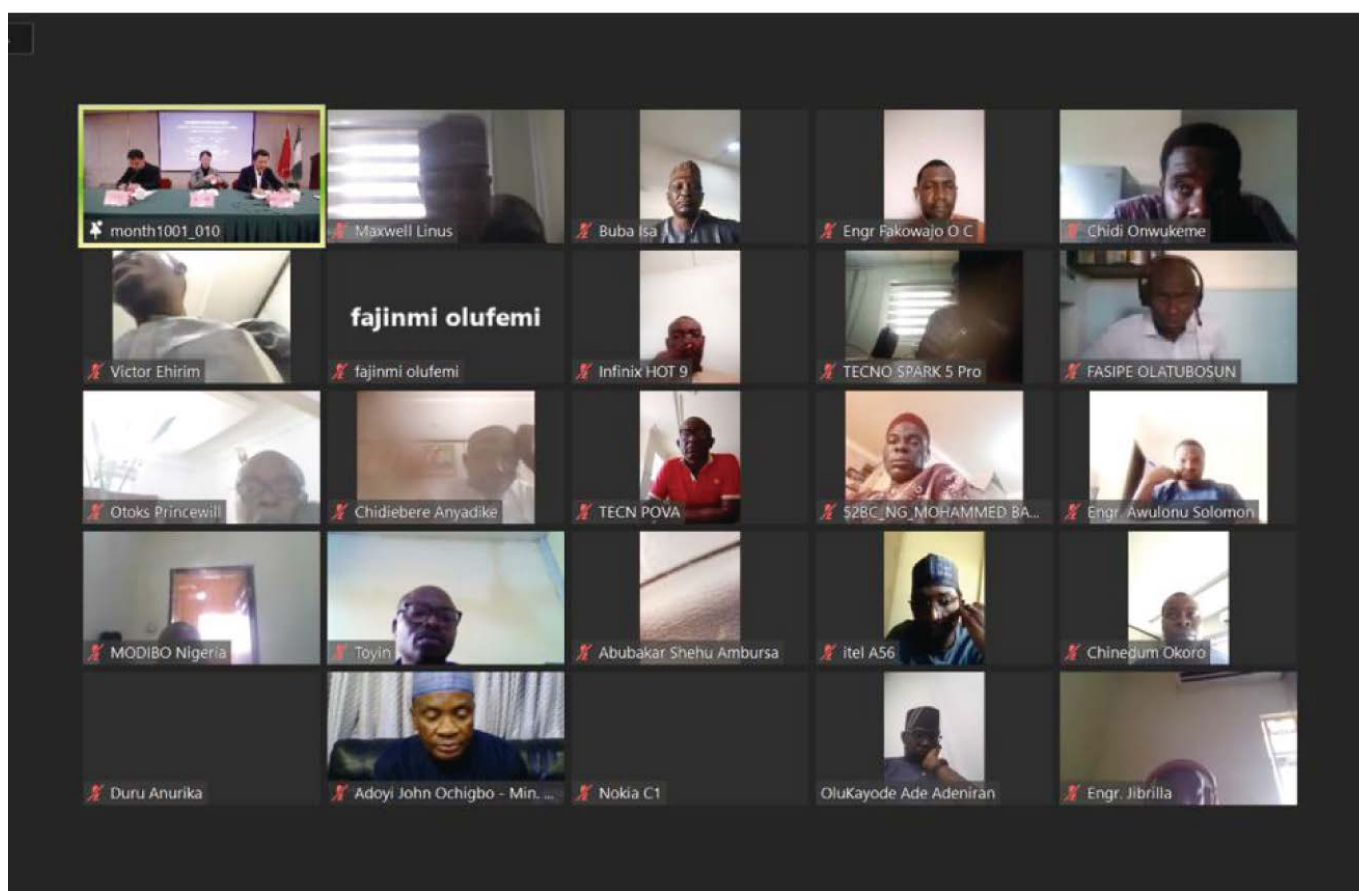


the “Seminar on Green Economy and Environment Protection for Developing Countries” was successfully held online. 97 officials and engineers from 19 countries including Afghanistan, Angola, Azerbaijan, Bangladesh, Cambodia, Ethiopia, Ghana, Malaysia, Mongolia, Morocco, Nepal, Pakistan, Panama, Rwanda, Sri Lanka, Thailand, Uzbekistan, Vietnam and Zambia attended the seminar. During the 14-day seminar, presentations such as Low Carbon Economy and Sustainable Development, Environmental Issues and Policies Related to International Trade, the Eco-City Theory and Its Practice, the Development and Application of Renewable Energy in China, etc. were delivered. Online visits to the demonstration projects of green economy and environmental

development were arranged, and in-depth discussion on cooperation in the fields of green development and renewable energy was carried out between officials and HRC staffs. This is the first time HRC undertakes the China-aid training program on the topic of green development, which has laid a solid foundation for further deepening and promoting the multilateral and bilateral cooperation on green economy and environmental protection under the background of carbon peaking and carbon neutrality goals.

### **VIII Training Course on Construction and Management of Water Conservancy and Hydropower for Nigeria**

From 9<sup>th</sup> to 22<sup>nd</sup> November, 2021, the “Training course on construction and management of Water Conservancy and hydropower for Nigeria” was successfully held online. Over 120 participants from Nigeria came to attend the 14-day training course. The training focused on the discussion and exchange on the development and utilization of small hydropower, the design, construction and management of hydropower projects and so on. Online visits were arranged to enable participants to have a better understanding of water culture and construction achievements in China. The training received unanimous praise by the participants and had great significance for small hydropower development in Nigeria and future cooperation.

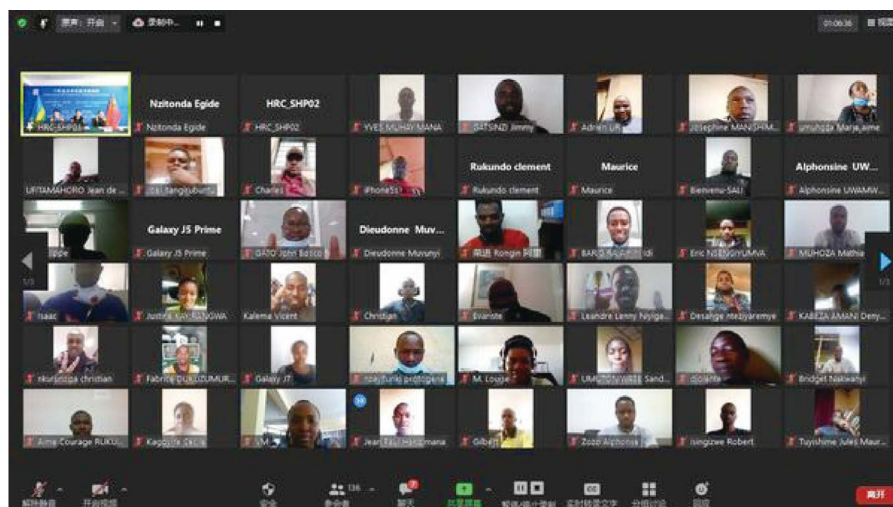






## IX Seminar on Small Hydropower Technology for Rwanda

From November 22<sup>nd</sup> to December 16<sup>th</sup>, the “Seminar on Small Hydropower Technology for Rwanda” was held online successfully. 137 participants from Rwanda Energy Group, University of Rwanda, Sustainable Agriculture and Livestock Initiative (SALI) and other local utilities and universities attended this rewarding event. It is the 6<sup>th</sup> training program conducted by HRC for Rwanda starting from 2015. During the seminar, participants listened to the presentations covering the technology, practice and experience in the field of renewable energy in China inclusive of SHP and solar energy, and carried out online visits to South-to-North Water Diversion Project, Water Conservancy System in Liangzhu Ancient City, Tianhuangping Pumped Storage Power Plant, Yucun Village with Green Development, NARI Group Corporation, National Water



Museum of China, etc. In addition, further bilateral cooperation on SHP was discussed in details, and traditional culture was shared via the rich activities, such as daily Chinese learning, the appreciation of Chinese paper-cutting, etc. 2021 marks the 50<sup>th</sup> anniversary of the establishment of diplomatic relations between the Republic of Rwanda and the People's Republic of China. With a wide range of participation, rich content, and fruitful results, the training programs have won unanimous praise from the competent authorities and partners in Rwanda, making positive

contributions to jointly promoting China-Rwanda cooperation and friendship and further deepening the bilateral relations.

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