

SMALL HYDROPOWER
DEVELOPMENT AND MANAGEMENT

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IN CHINA

MINISTRY OF WATER RESOURCES, PEOPLE'S REPUBLIC OF CHINA

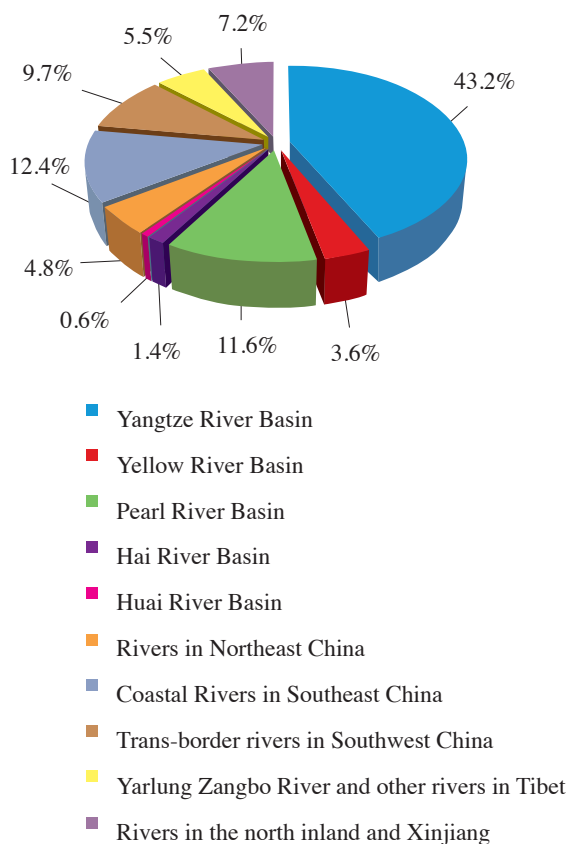


Fig.1 Distribution of potential exploitable rural hydropower resources by river basins

Small Hydropower Development and Management in China

1. Overview

Small hydropower projects refer to hydropower stations and their affiliated grids with $\leq 50,000$ kWh unit installed capacity. China ranks No.1 in the world in terms of small hydropower resources, i.e., the technically exploitable potential of small hydropower resources in mainland China is 128 million kW; annual power output exceeds 535 billion kWh; and small hydropower plants are distributed in 1,700 counties (cities) across the country in 30 provinces (autonomous regions and municipalities directly under the central government). As at the end of 2014, there were over

47,000 rural hydropower stations in operation, which, mostly being small hydropower stations, combined to a total installed capacity of 73 million kW, and total power output of 220 billion kWh in 2014, equivalent to substitution of 73 million metric tons of standard coal, and reduction of 183 million metric tons of CO₂ emission.

2. Main Achievements and Challenges

At present, tens and thousands of hydropower stations, including ultra-large hydropower stations such as the Three Gorges Project, have been built in China. As at the end of 2014, the installed capacity of hydropower in the country reached 300 million kW, and annual power output exceeded 1 trillion kWh per annum, the two of which together accounted for about 25% of the respective national total.

In the process of developing small hydropower, China has built up a technical standard system that covers multiple aspects of small hydropower projects including planning, designing, construction, installation, operation and maintenance, safety assessment, mechanical-electrical equipment, and material testing. At present, there are 52 valid small hydropower standards, including 14 national standards and 38 sector standards.

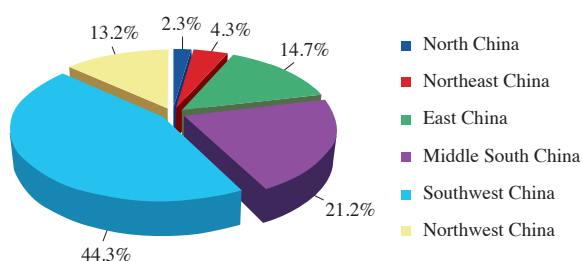


Fig.2 Distribution of potential exploitable rural hydropower resources by regions

2.1 Small Hydropower, Big Role

The development of small hydropower in China has achieved remarkable social, economic and environmental benefits. Among others, it has served the interests of the countryside, agriculture and farmers.

2.1.1 Accelerating the Electrification Process in Rural China

In 1983, the Chinese government initiated a campaign to enable its rural areas access to electricity via the development of hydropower. 653 counties gained preliminary access to hydropower during the 7th to 9th Five-Year Plan periods, and 432 counties did so during the 11th Five-Year Plan period. The ratio of rural households with access to electricity grew from 40% in 1980 to 99.8% at present, along with marked improvement in the quality and reliability of power supply, which basically resolved difficult access to electricity in mountainous rural areas.

2.1.2 Driving Forward Social and Economic Development in Rural Areas

The development pace of the 653 counties enjoying access to rural hydropower during the 7th to 9th

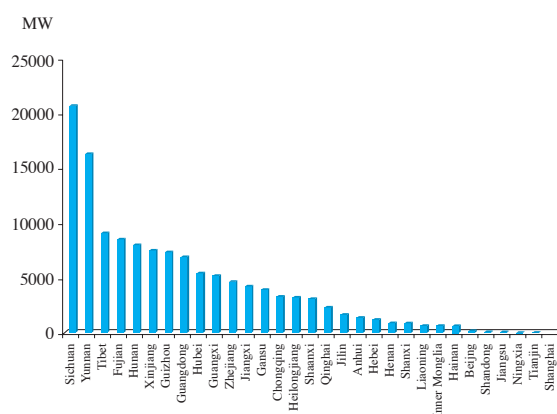


Fig.3 Ranking of provinces by potential exploitable rural hydropower resources



Jingrun Small Hydropower Station in Jingning County, Zhejiang Province

Five-Year Plan periods is remarkably higher than the national average. Those counties have basically realized the targets of doubling their GDP, fiscal revenue, per capita net income of farmers, and per capita power consumption every 5 years, and quadrupling those figures every decade. In the 409 counties with access to rural hydropower during the 10th Five-Year Plan period, their annual power consumption per capita is 644 kWh, 85.6% up over that of 2000. In the 432 counties that gained access to rural hydropower during the 11th Five-Year-Plan period, annual power output per capita grew from 631 kWh in 2005 to 1,025kWh, up 62.4%. The “New Countryside Hydropower Electrification Program” during the 12th Five-Year Plan period for increased installed capacity of rural hydropower network by 5 million kW, which accounted for over 50% of the total national incremental installed capacity of rural hydropower.

2.1.3 Improving Farmers’ Living Standards and Production Conditions

In many areas, the development of small hydropower plants helps improve local infrastructure, and promotes the development of public welfare. Isolated mountain villages have gained access to electricity, water supply and roads, and renovated their kitchens. Science and technology have been disseminated in rural areas. All these have brought enormous improvements to the lives of rural residents in mountainous areas. In many villages that have developed hydropower, the revenue from hydropower helps fund cultural, educational, communication, medical, social security and other public-good undertakings. Among others, seniors at and above the age of 60 are eligible for a “pension subsidy” in those localities.

2.1.4 Contributing to Energy Conservation and Emission Reduction

According to preliminary estimates, in terms of substituting firewood with small hydropower, the amount of power generated per 1,000 kWh installed capacity is equivalent to a saving of 4 metric tons of firewood per annum. In 2014, small hydropower output in China stood at 220 billion kWh, equivalent to a saving of more than 73 million metric tons of standard coal, reduction of 183 million metric tons of CO₂ emission, and reduction of 900,000 metric tons of SO₂ emission. The eco-protection pilot project on substituting fuel with small hydropower helped over 800,000 farmers replace fuel with small hydropower, which consequently protected more than 233,300 ha forest land. During the 12th Five-Year Plan period, 4,400 aging power plants will be expanded or upgraded, which will secure an incremental 9 million kW



Shilongba Hydropower Station in Kunming City of Yunnan Province, constructed in 1911 (the first hydropower station in China)

installed capacity to the rural hydropower networks, or 350 million kWh of power output each year, up 20% and 40% respectively compared to the corresponding figures before the expansion or upgrading.

2.1.5 Safeguarding Emergency Power Supply

When South China suffered freezing rain and snow storms in the beginning of 2008, small hydropower supplied starting-power to a number of large power plants, and served as a secure source of electricity to over 200 counties and 2,000 townships during the Spring Festival for their power consumption. In addition, it played a key role in maintaining power supply when the main power grids were restored following the natural disaster. Small hydropower also helped to keep the key railway lines including Beijing-Kowloon, Yingtan-Xiamen, Chongqing-Huaihua, and Hunan-Guizhou railways uninterrupted. In the aftermaths of the Wenchuan earthquake in Sichuan Province and Yushu earthquake in Qinghai Province, the affected population got their small hydropower stations repaired quickly and was able to resume power supply to many counties and areas shortly after the massive earthquakes.

2.2 New Challenges

(1) Rural hydro resources are mostly located in central and western China. The exploitable small hydropower in those regions accounts for 64% of the national total, but only records a 47% rate of development. The generally poor western regions are constrained in their financing capacity and therefore find it difficult to fund development of small hydropower.

(2) Specialized hydro resource development plans remain absent for the numerous medium and small rivers in China. Certain areas suffer disorderly development of the resources.

(3) The policies on environmental protection are



Small hydropower station in Chaling County, Hunan Province

tightening, as a result of which, developing rural hydropower has become technically more difficult. The situation is aggravated by the substantial rise in the costs of labor, land requisition, and relocation of affected population. Hydropower development projects are facing even more constraints such as eco-environmental considerations and resettlement requirements.

3. Objectives and Main Tasks

3.1 Development Objectives

As part of the campaign to make hydropower accessible to rural residents, it is imperative to substitute firewood with small hydropower, expand or upgrade rural hydropower facilities, and build new plants and expand or upgrade existing facilities, so that the 13th Five-Year Plan period will add 10 million kW incremental installed capacity to existing rural hydropower and thereby enable total installed capacity of rural hydropower to exceed 85 million kW by the end of 2020. The “dual-responsibility” system for operational safety (with the government as the main supervisor of operational safety and enterprises as the main responsible party for safe operation of power plants) should be put into place across the board; and extensive efforts should be made to develop standards on operational safety. Further, we

need to make green small hydropower a very popular concept, and remarkably improve the eco-environment in rural areas that develop hydropower. Moreover, a rural hydro resources management system that aligns responsibility and authority should be put in place whereby rural hydro resources will enjoy orderly development, sustainable utilization, and continuous improvement in sector management capacity.

3.2 Main Tasks

3.2.1 Speed up Rural Hydropower Development

As part of the campaign to make hydropower accessible to rural residents, it is imperative to



Shimenqiao Small Hydropower Station in Guangxi Zhuang Autonomous Region

substitute fuel with hydropower, and expand or upgrade rural hydropower facilities. Meanwhile, efforts should be made to expand investment from the central government, diversify hydropower projects, fully leverage the decisive role of the market in developing rural hydro resources, and encourage and guide social capital to invest more in rural hydropower facilities. The target is to add 10 million kW installed capacity to rural hydropower during the 13th Five-Year Plan period by building new projects, and expanding or upgrading existing facilities.



Farmer's kitchen before the implementation of Small Hydro Replacing Wood Fuel Project



Farmer's kitchen after the implementation of Small Hydro Replacing Wood Fuel Project



Improved eco-environment thanks to Small Hydro Replacing Wood Fuel Project

3.2.2 Proactively Transform the Pattern of Development

We will transform from focusing on new projects to attaching more importance to expanding/upgrading and sustainable use of existing hydropower plants; transform from emphasizing full utilization of hydro resources to highlighting limited, orderly, and paid development of hydro resources; transform from focusing on power generation to emphasizing comprehensive utilization, ecological functions and environmental benefits of hydropower stations; and transform from focusing on economic benefits to focusing more on local development and wellbeing of farmers.

3.2.3 Attach Great Importance to Ecological Conservation

Under the prerequisite of protecting the eco-environment, we will develop and utilize rural hydro energy in a scientific and orderly manner, so as to secure power supply for rural social and economic development and at the same time protect the eco-environment of rivers. Improvements will be made to planning hydro energy development on small and medium rivers in strict compliance with relevant laws and regulations. Eco-environmental protection will be reinforced throughout the whole process of planning, designing, construction and operation of rural hydropower projects. All these will proactively promote the development of green small hydropower.

4. International Cooperation and Exchanges

4.1 Establishment of International Organizations

In 1981, the Asia Pacific Small Hydropower Research & Training Center was established under the auspices of the UNDP and the then PRC Ministry of Foreign Trade and Economic Cooperation (MOFTEC). In 1992, following the joint initiative by international organizations including UNDP, UNIDO and UNESCO, relevant countries and the Chinese government, the International Network on Small Hydropower (IN-SHP) was established in 1994 with a membership of over 60 countries. In addition, the International Center on Small Hydropower was established in 1999 with Hangzhou as its headquarters. At present, over 470

members from 80 countries and regions in the world have joined IN-SHP. Its Coordination Committee has been successfully reelected, with the positions of Chairperson and Director-General continuing to be assumed by representatives from China. Hitherto, IN-SHP has established 3 regional sub-centers in Asia, Africa, and South America respectively, and 4 international small hydro demonstration bases in Chenzhou of Hunan Province, Zhangye of Gansu Province, Jinhua of Zhejiang Province, and Changsha of Hunan Province respectively.



The International Center on Small Hydro Power

4.2 Engagement in International Cooperation and Technical Training, and Assistance to Developing Countries in Capacity Building

Under the auspices of the United Nations and other international organizations, China has carried out international small hydropower cooperation programs in collaboration with UNDP, UNIDO, the Group of 77, and international assistance agencies from developed countries in the fields of rural energy, environmental protection and poverty reduction. These programs have helped promote and demonstrate small hydropower technologies, and enable Chinese experiences, wisdom and technologies to benefit other developing countries. Small hydropower training courses have been organized in China, France, India, Jamaica, Canada, Turkey, Greece, and Rwanda, etc., and an English training material Small Hydro Power

edited and printed. Training around 3,000 small hydropower technicians and engineers from over 100 countries, these programs have effectively promoted technology transfer and local development of small hydropower. The “Lighting-up Africa” Program has rolled out a series of hydropower plants (relevant work covered site screening, feasibility studies, and equipment supply / delivery / installation) and turn-key projects, winning high acclaim from the UN and recognition by African nations.

4.3 Construction of Platforms for International Small Hydropower Exchanges

Since 2005, IN-SHP has successfully organized 6 Today’s Hydropower Forums, featuring various themes such as Asia-Africa Small Hydropower Cooperation, Developing & Managing Small



Guanyinyan Small Hydropower Station in Guizhong Province

Hydropower in Africa, Small Hydropower and Improvement of Living Standards. The forum has served as an important platform for small hydropower exchanges among different countries. In 2013, the International Center on Small Hydropower and UNIDO jointly launched the first English version of the *World Small Hydropower Development Report 2013*. H. E. Mr. CHEN Lei, Minister of Water Resources, and H. E. Mr. LI Yong, Director-General of UNIDO both wrote prefaces for the report. The publication of *SHP News*, a special English journal on small hydropower and *IN-SHP Newsletter*, the English journal of IN-SHP further diversify such foreign exchange platforms.

4.4 Proactive Practice of the “Going Global” Strategy

By engaging in inter-governmental technical cooperation programs, including the “Sino-Pakistan Joint Research Center for Small Hydropower Technology”, China has provided effective and practical assistance to developing countries in their development of small hydropower resources on both theoretical and practical levels. Services ranging from planning, designing and consulting, to supply and installation of complete sets of equipment are rendered to hundreds of small hydropower stations in developing countries, which helps Chinese small hydropower technology and know-how to go global.



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