

**PEREZ-GUERRERO TRUST FUND FOR ECONOMIC AND TECHNICAL
COOPERATION AMONG DEVELOPING COUNTRIES**

(G77 Project)

Final Report

on

**Initiative of Research and Practice on Green Hydropower in China and selected
countries in Latin America**



INTERNATIONAL CENTRE ON SMALL HYDRO POWER

AUGUST 2014, HANGZHOU, CHINA

I. Project Overview

1. **Project Title:** Initiative of Research and Practice on Green Hydropower in China and selected countries in Latin America
2. **Abstract:** Hydropower is a potentially clean and environmentally friendly form of renewable energy. Most developing countries in Asia and Latin America are endowed with hydro resources. However, the traditional way of predatory development of hydropower witnesses a series of social problems including resource exhaustion and environment pollution, paying heavy price but leading to no sustainability. In this background, Green Hydropower is required in emergency for sustainable development of huge hydro potential. China and Latin American countries are typical examples. This project is to replicate the Chinese's practice on Green Hydropower and promote a universal modality in Latin America for energy security as well as sustainable development. By sharing the lessons and experiences, as well as showcasing the demonstration in selected countries in Latin America. In order to enhance the sustainability of the impacts further, such activities will be planned after the completion of the project cycle. Further cooperation will be ongoing between nations.
3. **Background Analysis:** Hydropower is a potentially clean and environmentally friendly form of renewable energy which contributes significantly to poverty alleviation and economic growth in developing countries. It occupies the significant status in global energy mix. Threatened by climate change and energy crisis, governments all over the world have dedication for development of hydropower as a priority. Notably, in some developed countries particularly in Europe and North America, averagely 80% of its hydro resource has been developed. Switzerland leads in this field with 86.6%, followed by Japan 84%, USA 82%, France and Norway 80%. While in Asia and Latin America, only 25% and 40% respectively of the continents' hydro resources have been developed, which is far behind the developed countries and remains huge potential. This is even though hydropower plays an important role for poverty alleviation and economic development in developing countries. However, the traditional way of predatory hydro development paid heavy price, sacrificing the ecological environment and sustainable development. In fact, this is the lessons learned from the history of hydro development in the developed countries in history.

Since 1980s, developed countries carried out large-scaled research on Green Hydropower, targeting at harmonization of resource exploitation, environmental protection and social development for hydro sustainability. In this sense, Green Hydropower embodies the concept of environmental protection and ecological harmonization. It is an attempt to breakthrough the conflict of hydro development and environmental protection. The Green Hydropower Certification Criteria from Switzerland and the Low Impact Hydropower Certification Criteria from the USA set the most successful examples for Green Hydropower, from which we can learn its specific natures:

- 1) The nature of lifespan. Each stage of Green Hydropower project including plan, design, construction, operation and management reflect its protection on coordinative development of environment, society and economy.
- 2) The nature of integration. Green Hydropower requires not only environmental protection, but also promotion of project benefits and social development.
- 3) The nature of coordination. Green Hydropower reflects inter-active promotion among the environment, economy and society, keeping a virtuous cycle for sustainability.

In addition, development of Green Hydropower, learned from the practice in developed countries, contributes as follows:

- 1) Reasonable and effective utilization of hydro resource & innovation of technologies
- 2) Promotion of ecological environment and low carbon economy
- 3) Acknowledgement of concepts on Green Hydropower and sustainable development.
- 4) Maturity of energy and economic policy

China is the most representative emerging developing country with huge hydro potential of which only 35% has been utilized. Similarly, Latin America has the same situation. Green Hydropower will play a significant role for low carbon economy, environmental protection and social development. The practice of Green Hydropower in developed countries based on the particular conditions in those countries and may thus not be adopted as such in poorer regions of the world. However, the research and practice of Green Hydropower in China could set a general example with guidelines and replication for Latin America as regards to similarities in social development.

In China, the law determines that the impacts of hydropower projects must be evaluated before construction. The negative impacts of hydropower projects have been widely recognised and people have become consciousness of environment protection. Organizations, such as International Centre of Small Hydropower and China Institute of Water Resources and Hydropower Research, have done some research work on sustainable hydropower development. There already exists some practice and research work about the assessment system of green hydropower and certification criteria. Some factors that have serious impact on the environment have been determined and measures that can recover the environment are also practiced and developed. By reservoir operation, sediments control, and project design, the impact from hydropower projects can be reduced. Since also in Latin America there are more and more hydropower projects being constructed, the principle of green hydropower should be carried out at the beginning of exploiting hydro power.

II. Implementation

China and Latin America are typical examples of regions where the development of hydropower has witnesses a series of social problems including resource exhaustion and

environment pollution, paying heavy price but leading to no sustainability. Therefore, development of Green Hydropower is urgent for realizing the strategy of sustainable development by optimizing energy mix, protecting ecologic environment, and improving livelihoods as well as decreasing GHG emission. However, Green Hydropower in China and Latin America is still in preliminary stage for pilot practice, and thus neither basic theories nor practical experiences are maturely proven yet. The purpose of this project is 1) to focus on theoretic research and stipulate standard criteria on Green Hydropower. 2) to promote national practice and accumulate valuable experiences. 3) to strengthen environmental protection, accelerate low carbon economy, and realize the sustainable development of hydropower. 4) to publicize the concept of Green Hydropower and set a referential model for replicating the project in developing countries

For implementation, the project can be divided into four distinct stages; only the first three stages are relevant to this current project document, with the remaining stage representing ongoing strategies into the future for replicating the system nationwide in the target countries and continents.

- 1) The first stage involves extensive survey and site reconnaissance in typical regions in China, carrying out the subject on Impacts of Green Hydropower to collect the first-hand information. A group of experts will be organized by IC-SHP for seminar on analysis and evaluation of the survey.
- 2) The second stage will be based on the outcomes of the survey in first stage, two upgraded research missions namely Analysis and Practice of the Survey on Impacts of Green Hydropower and Research on Chinese Certification Criteria and Evaluation System of Green Hydropower respectively will be completed by IC-SHP.
- 3) The third stage is to share the Chinese model of Green Hydropower Development in Latin America. Targeted countries in the continent will be selected for pilot cooperation on Green Hydropower. Forum and seminars, on-site consulting mission and case study will be organized by IC-SHP home or target countries, paving the way on further steps of Green Hydropower project.
- 4) Although the fourth stage is not directly relevant to this current proposal, it represents ongoing strategies in the future for replicating the project in target continents. IC-SHP will conduct in kind consulting activities on Green Hydropower practice in Asia and Latin America.

In order to guarantee the sustainability of the project the IC-SHP will continue to disseminate information and give practical advice with respect to the project results in Asia, Latin America and elsewhere in the world even after the end of the project cycle.

Beneficiaries: Direct beneficiaries will include government officials and other experts working in the field of hydropower in the target countries. Indirect beneficiaries include populations that may, as a result of the project, be spared from the harmful environmental and social impacts of hydropower development.

III. Completed Activities

Activity – 1

Time: June 2013

Location: Zhejiang, Guizhou, Gansu, Heilongjiang, Jilin Provinces

Implementation: By taking reference of The Green Hydropower Certification Criteria from Switzerland and the Low Impact Hydropower Certification Criteria from the USA which set the most successful examples for Green Hydropower, four typical basin areas namely Wujiang river, Songhuajiang river, Oujiang river and Heihe river located respectively in Southwestern, Northeastern, Southeastern and Northwestern China were selected as the targets of the Chinese green hydropower survey. The extensive survey was not only to collect basic national and local information of green hydropower on policies, laws and regulations, but also to cover the general situation of target basins and its main power stations. In addition, natural factors, ecological impacts and social economic development were included as well in the survey for further references.

Participants: ICSHP, MWR



Activity – 2

Time: July- September 2013

Location: Zhejiang, Guizhou, Hunan, Hebei, Guangxi, Sichuan, Shanxi, Jiangxi , Jilin Provinces

Implementation: ICSHP carried out 3-months site investigation with support of local counterparts in the target basin areas of Wujiang river, Songhuajiang river, Oujiang river and Heihe river respectively. The investigation which covered almost every aspect of potential impact factors on green hydropower included the natural environment, social-economic environment, hydro resources development, general situation of main power stations, hydrology, geology, climate, landscape, plants, animals, immigration and regional economy as well as public services.

Participants: ICSHP, local counterparts



Activity – 3

Time: July- September 2013

Location: Zhejiang, Guizhou, Hunan, Hebei, Guangxi, Sichuan, Shanxi, Jiangxi , Jilin Provinces

Implementation: Besides the site investigation, ICSHP also organized seminars with local counterparts, experts and project owners specifically in each target basin area in relevant provinces. Based on the outcomes of site investigation, the seminars focused particularly on deepened comparative analysis and evaluation of potential impact factors for green hydropower and current situation of hydro development. Furthermore, the seminars witnessed discussion and consultation of future guideline for promotion of sustainable development for green hydropower.

Participants: ICSHP, local counterparts





Activity – 4

Time: October 2013

Location: Zhejiang Province

Implementation: ICSHP initiated to organize a group of hydropower experts nationwide specifically for the project as intelligent support and host seminar for evaluation and strategies for further researches on green hydropower. Based on the analysis and complementation of the first-hand outcomes of the site investigation, a preliminary report was drafted and submitted to the experts group for review and evaluation. According to opinions of the expert group, the preliminary report was to be revised and supplemented for further review and evaluation. Besides, the seminar also focused on discussion of strategies for deepened researches in next stage.

Participants: ICSHP, MWR



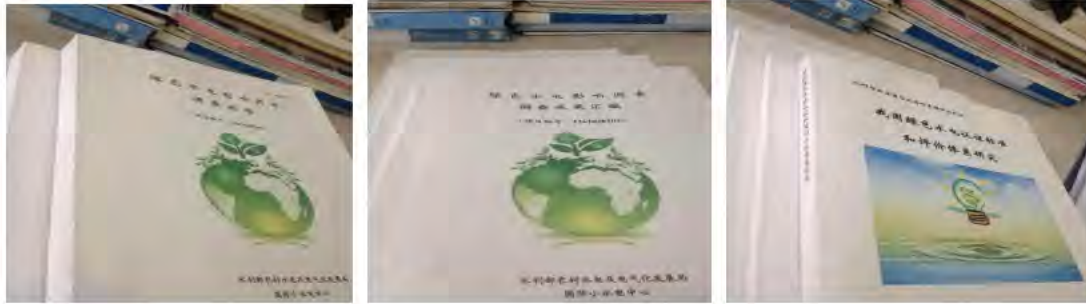
Activity – 5

Time: November 2013 – April 2014

Location: Zhejiang Province

Implementation: Based on the outcomes of the extensive survey and site investigation in the first stage as well as the revised preliminary report after seminars of national experts group, updated researches including the *Investigation Report of Impact Factors on Green Hydro Power*, the *Evaluation System and Application Guideline of Green Hydro Power* and the *Technical Regulations for Investigating Green Hydro Power Impact Factors* were successfully completed. And general contents as well as outlines of all the reports are translated into English for reference as Appendix.

Participants: ICSHP



Activity – 6

Time: October 2013

Location: Brazil

Implementation: The regional forum on small hydropower development particularly for Latin American countries was held in Brazil by ICSHP and local counterparts. And the session of replicating Chinese practice on green hydropower in Latin America was the very key part of the forum. It was to share the achievements of the research and practice of Green Hydropower in China which could set a general example with guidelines and replication for Latin America as regards to similarities in social development. Since the similarity that Latin American has huge hydro potential but with low proportion of utilization and the fact that there are more and more hydropower projects being constructed, the forum provided specific platform for sharing and replicating the Chinese practice with Latin American countries aiming at promotion of sustainable development of green hydropower.

Responsible by: ICSHP, local counterpart



Activity – 7

Time: March 2014

Location: Colombia

Implementation: Joint mission of on-site consultation for case study was organized by ICSHP and local counterpart. The practice of Green Hydropower in developed countries based on the particular conditions in those countries and may thus not be adopted as such in poorer regions of the world. However, China and Latin America are similar in small hydropower development and thus green hydropower will play a significant role for low carbon economy, environmental protection and social development. Therefore, the research and practice of Green Hydropower in China could set a general example with guidelines and replication for Latin America as regards to similarities in social development specifically for sustainable development of green hydropower.

Responsible by: ICSHP, Local counterpart



Activity – 8

Time: May 2014

Location: Zhejiang Province

Implementation: As follow-up activity of the international forum on green hydropower particularly for Latin American countries was held in Brazil, ICSHP particularly organized a study tour in China to demonstrate the achievement of small hydro power development and its practise of green hydropower in typical river basin. Zhejiang is one of the pioneering provinces with abundant of hydro resources and leading in green hydropower for sustainable development.

Responsible by: ICSHP



Activity – 9

Time: June 2014

Location: Hangzhou, ICSHP

Implementation: Although the activities within the project proposal have been completed successfully with fruitful achievements after the end of the project cycle, the project itself is to be continued with follow-up activities. Ongoing strategies in the future for replicating the project in target continents will be conducted by ICSHP in kind by consulting activities on green hydropower practise in Asia and Latin America. In order to guarantee the sustainability of the project, IC-SHP will continue to disseminate information and give practical advice with respect to the project results in Asia, Latin America and elsewhere in

the world, paving the way on further steps of green hydropower project cooperation and promotion worldwide.

Responsible by: ICSHP

IV. Financial Costs and Expenses

The project costs for activities are strictly based on the financial budget. IC-SHP organized financial staffs specifically for evaluation and review of the economy for the project. Project leaders are also responsible for monitoring of cost for each activities regarding to the project and required for submission of periodical report to the Director General of IC-SHP for processing and stage of the project.

No.	Items	PGTF Fund	ICSHP Fund	Total
1	International travel	15,000 USD	30,000 USD	45,000 USD
2	Equipment purchase	0	0	0
3	Experts fees	5,700 USD	20,000 USD	25,700 USD
4	Trainings	0	0	0
5	Meetings	0	14,400 USD	14,400 USD
6	Domestic travels	0	13,500 USD	13,500 USD
7	Administration fee	0	10,000 USD	10,000 USD
8	Unpaid PGTF fund	2,300 USD	0	2,300 USD
	Total	23,000 USD	87,900 USD	110,900 USD

V. Project Management and Monitoring

The project is implemented by the International Center on Small Hydropower (IC-SHP). The Chinese government appointed the Ministry of Water Resources (MWR) to ensure that national support for research and development of SHP. Chinese governments & the PGTF will co-finance the proposed consultation missions, case study on the selected SHP projects, seed money for project construction. IC-SHP(in-kind) & PGTF will co-finance the trainings. IC-SHP will provide ‘in-kind’ assistance for projects, which will form part of the budget contributed by the Chinese government. Progress and monitoring will be done by China International Center for Economic and Technical Exchanges, Ministry of Commerce, the People’s Republic of China.

Annex: Breakdown of Expenditure

Expenses covered by the PGTF

International Travel	US\$15,000
International Transportation	US\$10,000
Local Transportation	US\$1,000
Local Accommodation	US\$25,00
Living Allowance	US\$1,000
International Telecommunication	US\$500
Experts Fees	US\$5,700
Consulting Fees	US\$3,700
Accommodation	US\$1,000
Living Allowance	US\$1,000
Subtotal	US\$20,700
Unpaid	US\$2,300
Total	US\$23,000

Appendix

Investigation Report of Impact Factors on Green Hydro Power

1. Introduction
 - 1.1 Project Objective
 - 1.2 Mission and Tasks
 - 1.3 Technical roadmap

2. Selection of Investigation Factors and Target Regions
 - 2.1 Selection of Investigation Factors
 - 2.1.1 Consideration of Main Environment-related Problems for Hydropower Development
 - 2.1.2 Reference of Evaluation on Environment Impact of Chinese Hydropower Projects
 - 2.1.3 References of Current Evaluation Systems for Foreign Hydropower Projects
 - 2.1.4 Preliminary Selection of the Impact Factors of Green Hydropower
 - 2.2 Selection of Target Basins and Power Stations
 - 2.2.1 Selection Principles
 - 2.2.2 Selection of Typical Basins and Power Stations
 - 2.2.3 Collection of Regional Typical Basins and Power Stations

3. Investigation of Impact Factors
 - 3.1 Impact Factors of Natural Aspect
 - 3.1.1 Hydrology
 - 3.1.2 Water Quality
 - 3.1.3 Water Temperature
 - 3.1.4 Environmental Geology
 - 3.1.5 Local Climate
 - 3.1.6 Landscape and Relics
 - 3.2 Impact Factors of Ecological Aspect
 - 3.2.1 Terrestrial Organism
 - 3.2.2 Aquatic Organism
 - 3.3 Impact Factors of Social Aspect
 - 3.3.1 Land Acquisition and Immigration
 - 3.3.2 Comprehensive Utilization
 - 3.3.3 Local Economy
 - 3.3.4 Public Services

4. Distinguishing of Impact Factors and Structuring of Index Systems
 - 4.1 Distinguishing and Selecting of Impact Factors for Green Hydropower
 - 4.1.1 Distinguishing of Regional Impact Factors
 - 4.1.2 Distinguishing and Selecting of National Impact Factors

- 4.1.3 Distinguishing and Selecting of Impact Factors for Rural Hydropower
- 4.1.4 Impact of Hydropower Development's Approaches for Distinguishing and Selecting of Impact Factors
- 4.2 Structuring of Evaluation and Index Systems for Green Hydropower
 - 4.2.1 Framework and Content of Evaluation System
 - 4.2.2 Index content and Evaluation Method
- 4.3 Chinese Standard of Green Hydropower Development
 - 4.3.1 Moderate Development
 - 4.3.2 Eco-friendly Environment
 - 4.3.3 Effective Guarantee

- 5. Advice on Principals and Ideas for Chinese Green Hydropower Development
 - 5.1 Basic Principals of Chinese Green Hydropower Development
 - 5.1.1 Integrated planning and Moderate Development
 - 5.1.2 Protection of Local Ecological Environment
 - 5.1.3 Protection of Rural People's Benefits
 - 5.1.4 Serving Regional Economic Development and Social Progress
 - 5.2 Basic Ideas of Chinese Green Hydropower Development
 - 5.2.1 Integrated Planning
 - 5.2.2 Standardized Hydropower Development
 - 5.2.3 Emphasized Protection for Ecological Environment
 - 5.2.4 Protection of Rural People's Benefits
 - 5.2.5 Mechanism Construction
 - 5.3 Prospect

Evaluation System and Application Guideline of Green Hydro Power

- 1. Evaluation of Green Hydropower

- 2. Index Systems for Evaluation of Green Hydropower
 - 2.1 Framework and Content of Index Systems
 - 2.2 Index Implication and Evaluation Method
 - 2.3 Index Classification

- 3. Evaluation Method
 - 3.1 Single Index Evaluation
 - 3.2 Comprehensive Evaluation

- 4. Application Guideline of Evaluation Index Systems for Chinese Green Hydropower
 - 4.1 Objective and Purpose

- 4.2 Application Scope
- 4.3 Personnel Requirement
- 4.4 Site Investigation
- 4.5 Analysis and Evaluation
- 4.6 Report Compilation
- 4.7 Notes and Attention

Technical Regulations for Investigating Green Hydro Power Impact Factors

- 1. General Principals
- 2. Terminology
- 3. Investigation Contents and Data Acquisition
 - 3.1 Project Introduction
 - 3.2 Natural Impact Factors
 - 3.3 Ecological Impact Factors
 - 3.4 Social Impact Factors
 - 3.5 Countermeasures of Environment Protection
 - 3.6 Environment Monitoring and Management
- 4. Requirement of Investigation and Profile Collection
- 5. Implementation Method
- 6. Implementation Procedures
 - 6.1 Collection of Data Profile
 - 6.2 Site Investigation
 - 6.3 Outcome Compilation
- 7. Compilation of Investigation outcomes