Small Hydro Development Opportunities and Present Status in Nepal

H.K. Ghimire

Nepal Electricity Authority, Darbar Marg, Kathmandu, Nepal

E-mail: *hkghimire@info.com.np*

ABSTRACT

This paper basically gives insights on opportunities of small hydropower development and present status in Nepal. Also, focuses on energy supply situation with regard to hydropower development, particularly small hydro.

Nepal, located on the lap of mighty Himalayas, has about six thousand rivers and rivulets hurling towards India with huge potential of hydropower generation. Being a small but rich in hydropower resources, Nepal, boasted its first hydropower plant way back in 1911. Considering the geographical situation, small and medium sized hydropower projects seem more suitable in Nepal. Despite 42,000 MW of economically feasible hydropower potential, less than 2% of this potential has been exploited so far. Hydropower plants having capacity between 100 kW and 10 MW are considered as small hydros. Government of Nepal (GoN) is trying hard in fulfilling the ever-increasing demand of electricity in the country- particularly in rural areas. After the promulgation of Hydropower Development Policy 1992 and revised Hydropower Development Policy 2001, apart from the traditional public sector, private investors and local communities/co-operatives also have shown keen interest in generation and distribution of electricity in the country.

In 1974, Small Hydel Development Board (SHDB) was established. The main objective of the establishment of SHDB was to implement small scale – isolated type hydropower plants up to 5000 kW and supply electric energy to the surrounding areas of the plant. To date, forty six small hydropower plants are in operation in Nepal with total capacity reaching nearly 50 MW. Also, there are about 1500 mini-micro hydropower plants - including portable type Pelton sets - supplying limited electricity in far-flung villages of the country mainly for lighting purpose.

*Two important gatherings "**Hydropower Invest Mart 2006**" and "**Power Summit 2006**" were held in Kathmandu last year as a common forum of all stakeholders who can contribute towards the speedy and sustainable development of hydropower. Many investors and experts had participated in those meetings and highlighted many important issues regarding hydropower development in Nepal.*

1 INTRODUCTION

Nepal is a land locked country bordered by India to the South, East and West and by China (Tibetian Autonomous region) to the North. Covering an area of 147,181 sq.km Nepal is roughly rectangular in shape, with an average length from east to west 885 km and a width from North to South varying 145 to 241 km. Located on the lap of Himalayas, Nepal's elevation varies from 70 m to 8848 m (Mount Everest). Geographically, Nepal is divided into three parallel belts consisting of the mountains to the North, the hills in between, and the terai plain to the south.

Nepal has predominantly an agricultural economy and about 85 percent of the economically active population is engaged in agriculture. Still, 80% of the energy need of the country is met by the traditional energy sources such as fuel-wood, agri-residue and animal dung. It is estimated that only 40% of the total population of around 26 million has electricity through different sources like national grid, isolated small and mini hydro systems as well as solar home systems so far. But, most of the population living in rural areas is using electricity mainly for lighting purpose.

Despite huge potential of hydropower, its development could not take momentum as aspired by the general mass of Nepalese people due to some key impediments. Low level of basic infrastructure, limited power market within the country, low load factor, indefinite cross border power market, financial constraints, limitation in bigger project development, immature in-house capability and unstable socio-political situation are the main challenges in the speedy development of hydropower in Nepal.

2 HYDROPOWER DEVELOPMENT

Pharping Hydro of 500 kW was the first hydropower plant in Nepal established way back in 1911. But, after a long interval of 25 and 29 years two other hydropower plants namely Sundarijal 900 kW (640 kW after interchanging of frequency from 60 HZ to 50 HZ) and Panauti 2400 kW came into operation. As the demand of electricity increased mainly onwards from 60's bigger hydropower plants were constructed. In ten years period from 1965 to 1975 the installed capacity of hydropower increased almost 20 times.

Establishment of Small Hydel Development Board in 1975 to electrify remote laying district centers through isolated small scale hydropower projects led to categorization of hydropower plants in Nepal as follows:

- Plants less than 100 kW : Mini-micro Hydropower
- Plants from 100 kW to 10 MW : Small Hydropower
- Plants from 10 MW to 300 MW : Medium Hydropower and
- Plants above 300 MW : Big Hydropower

The objective of this classification is that mini-micro hydropower plants are meant for isolated rural areas, small hydropower plants are slated for rural market places as well as grid connection, medium hydropower plants are envisaged for national demand of power and energy, and large hydropower projects are planned for long term national demand and provision of export to neighboring countries. However, export of hydropower to neighboring countries other than India seems illogical in the present context.

3. POLICY OF THE GOVERNMENT

For the development of hydropower, the only abundantly available natural resource of Nepal, and electrify rural areas of the country, Government of Nepal (GoN) sets the following priorities in subsequent five yearly development plan.

Electrification programs will be made extensive to augment the development and expansion of agriculture production and of cottage and small-scale industries in the mountainous and Terai (plain area bordering with India) regions of the country. For the implementation of these programs, small and mini hydropower plants will be developed where electrification can't be provided through the Inter Connected Nepal's Power System (INPS).

Electrification programs will be implemented in the district headquarters and other places of the country to maximize the utilization of limited resources on the basis of the following considerations:

- area with economic potentials
- area with possibility of underground and pump irrigation, and the development of cottage and small-scale industries.
- adjoining areas where electrification works have already been completed and
- area in proximity of hydropower plants.

- Development of hydropower plants through public and private sector participation by simplifying licensing process and providing incentives.

To achieve the above-mentioned objectives, GoN has promulgated new Hydropower Policy 1992, Electricity Act 1993 and Electricity Regulation 1994. As per the policy and act many incentives and facilities are provided to enthusiastic private investors. No license is required for a hydropower project having capacity up to 1000 kW, and for the projects of more than 1000 kW the procedures have been simplified.

In October 2001, HMG of Nepal promulgated revised and updated "Hydropower Development Policy – 2001"addressing the issues like private investment, environment protection, export of electricity and rural electrification. Apart from NEA, there are several independent power producers (IPPs), some of which have already established hydropower plants and selling electricity to NEA. They are Himal Power Limited, Bhotekoshi Power Company, Chilime Power Company, National Hydropower Company and Arun Valley Hydropower Company. There exist other hydropower-development companies also in Nepal, which have concluded PPA with NEA, and are in process of project implementation.

There are almost 4000 Village Development Committees (VDCs) in Nepal and almost 2000 VDCs have been electrified to the end of ninth five-year plan. In its tenth five-year plan (2002 – 2007), the government of Nepal has adopted poverty reduction strategy (PRS) as a major challenge, in which rural electrification is a prime component. An ambitious target to electrify 2000 more VDCs has been envisaged, out of them 1000 VDCs will get electricity from the INPS and remaining 1000 VDCs will be electrified from disintegrated micro-hydro and solar home systems. To boost participatory approach and involve grassroots people in development process, the plan also envisages formation of local co-operatives or user's groups for rural electrification through grid extension as well as through the development of small-scale hydropower plants up to 500 kW.

Licensing, Royalty and Tax Policy Announced by the Government to Attract Private Investors in Small Hydropower Sector:

A. For Small Hydropower Project 1000KW or Less

- No License Required
- No Royalty
- No Corporate Income Tax

B. For Small Hydpower Plants Greater than 1000KW

License

Issued By: MOWR (Ministry of Water Resources)
License Period: 50 Years

Royalty

For First 15 Years
NRS. 100/KW installed capacity/annum
2% of energy sales
After First 15 Years
NRS. 1000/KW installed capacity/annum
10% of energy sales

Corporate Income Tax

15 Years tax holiday thereon 10% less than normally levied.

Import Facilities
(equipment, machinery, tools and spares)
1% customs duty on items no manufactured in Nepal.
Import license fee and sales tax exempted

Community Rural Electrification

With the restructuring of NEA in 2003, a community based generation and distribution mode was envisaged. This is grouped as individual, joint and collective - are named as 'community based generation', 'community based rural electrification' and 'community based operation and maintenance' models.

In each model, the primary condition is to be fulfilled by a community is that, it should be a registered institution as provided by the laws and must be constituted from among the local electricity consumers. In all the models, the community is responsible for the operation and maintenance of leased distribution system and should also be responsible for the payment of electricity consumed including both the technical and non-technical losses of the system.

Among others the following are the main features of community based on grid rural electrification system:

- to develop a coherent framework and suitable concept for cost effective, technically and socially appropriate rural electrification, which is well managed by established user cooperatives in the rural areas to be electrified.

- to develop and establish user cooperatives to be able to maintain the low voltage distribution system in the load centres.

- to support suitable means for development of productive end-uses application in electrified rural areas.

- to construct cost-effective distribution infrastructure in rural areas, with the aim of connecting as many costumers as possible within the frame work of the budget available either provided by HMG or various other donors.

- to implement, own and operate SHPs up to 500 kW for which GoN has made a provision to provide NRS 75,000 per kW (1150 US$ per kW) electricity generation.

- also, to implement line extension programs for rural electrification, GoN provides a grant assistance of 80% of the total cost and rest 20% has to be mobilized by the communities themselves.

To promote further activities by encouraging the involvement of the local population in the operation and maintenance of distribution system, NEA has formulated "Community Electrification Regulation 2002" to lease out the extended RE distribution systems.

3 SMALL HYDROPOWER

Established in 1975, Small Hydel Development Board (SHDB) was engaged in planning, survey, design, implementation and operation/maintenance of small hydropower plants throughout Nepal. Later in 1985, Nepal Electricity Authority (NEA) was formed as per the policy of GoN to look after all electricity related works by merging Electricity Department, Nepal Electricity Corporation and SHDB.

Fig 1: Bifurcation arrangement of a 2000 kW SHP in Western Nepal

Table – 1 Existing Small Hydropower Plants*

S. No	Name of the Plants	District	Capacity (kW)	Year in Operation	Remarks
1	Pharping SHP	Kathmandu	500	1911	Out of Service
2	Sundarijal SHP	Kathmandu	640	1935	Grid Connected
3	Panauti SHP	Kavrepalanchowk	2400	1965	Grid Connected
4	Phewa SHP	Kaski	1088	1967	Grid Connected
5	Dhankuta SHP	Dhankuta	240	1971	Grid Connected
6	Surkhet SHP	Surkhet	345	1977	Grid Connected
7	Phidim SHP	Panchthar	240	1981	Isolated, DHQ
8	Tinao SHP	Rupandehi	1000	1978	Grid Connected
9	Baglung SHP	Baglung	200	1981	Grid Connected
10	Doti SHP	Doti	200	1981	Isolated, DHQ
11	Jumla SHP	Jumla	240	1982	Isolated, DHQ
12	Jomsom SHP	Mustang	240	1982	Isolated, DHQ
13	Seti SHP	Kaski	1500	1985	Grid Connected
14	Salleri–Chialsa SHP+	Solukhumbu	400	1986	Isolated, DHQ
15	Darchula SHP	Darchula	300	1992	Isolated, DHQ

16	Taplejung SHP	Taplejung	125	1988	Isolated, DHQ
17	Tehrathum SHP	Tehrathum	100	1988	Isolated, DHQ
18	Bhojpur SHP	Bhojpur	250	1989	Isolated, DHQ
19	Khandbari SHP	Sankhuwasabha	250	1989	Isolated, DHQ
20	Bajhang SHP	Bajhang	200	1989	Isolated, DHQ
21	Chaurjhari SHP	Rukum	150	1989	Isolated, DHQ
22	Serpodaha SHP	Rukum	200	1989	Isolated, DHQ
23	Okhaldhunga SHP	Okhaldhunga	125	1990	Isolated, DHQ
24	Bajura SHP	Bajura	200	1990	Isolated, DHQ
25	Arughat SHP	Gorkha	150	1990	Isolated, Villages
26	Surnayagad SHP	Baitadi	200	1991	Isolated, DHQ
27	Rupal Gad SHP	Dadeldhura	100	1991	Isolated, Villages
28	Tatopani SHP	Myagdi	2000	1991	Grid Connected
29	Andhi Khola SHP**	Syangja	5100	1991	Grid Connected
30	Namche SHP+	Solukhumbu	600	1993	Isolated, Villages
31	Achham SHP	Achham	400	1995	Isolated, DHQ
32	Kalikot SHP	Kalikot	500	1999	Isolated, DHQ
33	Dolpa SHP	Dolpa	200	1999	Isolated, DHQ
34	Syange SHP**	Lamjung	183	2001	Grid Connected
35	Indrawati Khola SHP**	Rasuwa	7500	2002	Grid Connected
36	Piluwa Khola SHP**	Sankhuwasabha	3000	2003	Grid Connected
37	Heldung SHP	Humla	500	-	Under Construction
38	Gam Gad SHP	Mugu	400	-	Under Construction
39	Puwa Khola SHP	Ilam	6200	2000	Grid Connected
40	Rairang Khola SHP**	Dhading	500	2004	Grid Connected
41	Sunkoshi Khola SHP**	Sindhupalchok	2500	2005	Grid Connected
42	Chaku Khola SHP**	Sindhupalchok	1500	2005	Grid Connected
43	Khudi Khola SHP**	Lamjung	4000	2006	Grid Connected
44	Sisne Khola SHP**	Palpa	700	-	Under Construction
45	Baramchi Khola SHP**	Sindhupalchowk	1000	2006	Grid Connected
46	Thopal Khola SHP**	Dhading	1640	-	Under Construction
		Total	**49,906**		

* - Previously called SHP Plants of less than 100 kW are not included in this list
+ - Local Company (Community). ** - Private IPPs

4.1 Opportunities

After the promulgation of hydropower development policy 1992 and revised hydropower development policy 2001, private sector's participation in small hydro development seems encouraging. Under the Ministry of Water Resources there is a Department of Electricity (DoED). Apart from other responsibilities, the main functions of the DoED are:

- Conduct survey, feasibility study and selection of hydropower projects in the country
- Promote and develop private sector participation in the electricity development
- Provide license and necessary facilities to the private entrepreneurs
- Assist Ministry of Water Resources in monitoring and evaluation of electricity related development works

Almost six thousand rivers and rivulets that criss-cross the country have huge potential of small hydropower development. New viable sites are being identified as the national grid and access road is being extended. So far nearly 300 licenses, mostly for small hydros, have been issued by DoED

Fig 2: One of the 250 kW unit of a 2 MW SHP plant in Western Nepal

4.2 Present Status

The then SHDB is presently working under NEA as a separate department named as "Small Hydropower and Rural Electrification Department". So far, forty-six small hydropower plants (Table 1) have been established including six plants under construction. Most of the plants are in operation in isolated mode, and only a few of them are connected to the national grid system. Due to operational difficulties from the public sector (NEA), eleven isolated type small hydropower plants have been leased out to private party or community operators. As per the new policy of the government, NEA now is working further to divest the ownership of SHP plants up to 5000 kW and hand over them to local communities or enthusiastic private entrepreneurs.

Private participation in small hydro development that took momentum, particularly, after the new hydropower development policy announcement is encouraging. Under NEA there is a separate "Power Trade Department", which concludes PPA (Power Purchase Agreement) with the enthusiastic Independent power producers (IPPs). The major function of this department is to process applications for PPA with the IPPs. Besides this, the department also coordinates the power exchange and trade with India, monitors and provides support in administration of the PPA including invoice processing and coordination committee meetings.

As of June 2007 a total of 33 PPAs for SHP projects have been signed with a total installed capacity of 128 MW. Out of these, nine projects with total installed capacity of 25 MW are in operation. And, 6 projects with total installed capacity of 12 MW are under construction. Now, a total of 36 applications for PPA are under various stages of study. Power evacuation has emerged as the most important issue, impending speedy conclusion of PPA.

5 CONCLUSION

Nepal has made considerable progress in the field of small scale water resources projects in terms of capacity building, project management, and legal instruments, particularly in the last decade. Considerable efforts have been made by the government to attract the private sector in the hydropower sector. Appropriate environmental act, rules and guide lines are also in place for the selection, planning, design, implementation and operation of infrastructure project. As a result, out of nearly 560 MW installed capacity of hydropower, private sector owns and operates 150 MW.

Hydropower as a nonpolluting, environmentally friendly, renewable, locally available and reliable source of energy needs to be exploited to the fullest ambit possible. To meet the national energy objectives, small scale hydropower plants are effective for the electrification of remote isolated areas. In due course, these plants can be interconnected and make local grid systems. Later the local grids can be hooked to the national grid system. Thus reliability and stability of power grid can be achieved due to unique operating characteristics of hydropower.

Electrification is not a big problem where INPS can be brought in economically. But, in very remote areas, where INPS cannot be extended in the near future due to economic reasons, a group of interconnected small hydropower plants can be the viable option for sustainable rural electrification. For this purpose, project sites, target areas and load centers should be carefully selected. Ultimately, local grids can be connected to the INPS in the long run and the system can function economically and reliably. With its limited technical ability and financial resources, Nepal alone is not in a position to construct many small hydropower plants and establish local grids in remote hilly areas of Nepal. Hence, GoN of Nepal needs to create conducive environment for foreign assistance and request the developed countries for offset investment under the clean development mechanism (CDM).

REFERENCES

Energy South Asia, Vol 1, Issue 4, May-June 2002, New Delhi

Ghimire, H.K. 1995, *Small Hydropower Development in Nepal*, a Country Paper presented in Hangzhou Regional Centre on Small Hydropower, Hangzhou,

Ghimire, H.K. *Hydropower Potential and Development in Nepal,*The International Journal on Hydropower & Dams, Issue 1, 2002

Ghimire, H.K. 2002, *Role of Small Hydro in Poverty Alleviation and Environment Preservation: A Nepalese Perspective,* 5th Conference on Electrification Generation and Transmission, New Delhi

Honningsvag, B., G.H. Midttomme, K.Repp, K.Vaskinn & T. Westeren, (eds) 2001, *Hydropower in the New Millenium,* Rotterdam, Balkema

Japan International Cooperation Agency & Nepal Electricity Authority, 2003, *The Basic Study for the Rural Electrification through Small Hydropower Development*, Final Report, Kathmandu

Nepal Electricity Authority, Half Yearly Bulletin, Vidyut 1999 – 2002, Kathmandu

National Planning Commission, Nepal, 2003, *Tenth Five Year Plan (2003 –2007), High Priority Sector – Rural Electrification Work Plan*

T. Jiandong, 1997, *Small Hydropower: China's Practice*, International Network on Small Hydropower, Hangzhou