Perspective on Mini- and Micro-Hydropower Development

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Background

Nepal has a long history of hydropower use. The first effort to modernise the *ghatta* - the traditional water mill - began in the sixties. There is immense potential for the development of mini-and micro-hydropower in Nepal with 6,000 rivers and streams criss-crossing its mountainous terrain.

Mini-and Micro Hydropower (MMHP) schemes combine the advantages of large hydro plants, on the one hand, and decentralised power supply, as with diesel sets, on the other. They do not have many of the disadvantages, such as costly transmission and environmental problems, of large hydro plants, and dependence on imported fuel and need for highly-skilled maintenance personnel, as in the case of diesel plants. Moreover, harnessing small hydro resources, being decentralised, leads to decentralised use and local implementation and management, thereby making rural development possible through self reliance and the use of local natural resources.

The energy of micro-hydro plants is best used when the larger part is consumed on the spot as mechanical energy, without the intermediary of electricity generation and transmission. This is applicable to decentralised agro-processing, sawing, and water lifting. Micro-hydro units solely for electricity generation are often not economical because of the high unit costs. MMHP installation does not require elaborate construction work in reinforced concrete or expensive powerhouses and highly-optimised electro-mechanical equipment. Feasibility studies and the planning of installations can be simple. High standards of safety in construction works are often not necessary, as even the rupture of a small diversion weir would not usually threaten human life, and the risks are smaller anyway if the initial costs of construction work are kept down. For electricity generation, standards for voltage, frequency fluctuations, and the reliability of supply can usually be modest, involving considerable savings, without substantially reducing the overall benefits of a scheme.

Needs and Rationale

The scattered settlement patterns in the hills and mountains of Nepal make electricity grid extension to most of these areas unfeasible. One viable option for providing energy to the rural hill areas could be decentralised energy systems, such as MMHP, which exploit the indigenous energy resource base and knowledge system by appropriately integrating local management skills.

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The provision of mechanical and/or electrical energy from MHP schemes will help to increase the living standards of the rural people as well as help to rectify the ecological imbalance. For example, MMHP schemes could contribute to the following.

i) The substitution of fuelwood for cooking and heating in the commercial and residential sector and agro-based rural cottage industries
ii) The reduction of human drudgery, especially of women, by substituting manual agro-processing
iii) The increase in income-generating activities
(iv) The reduction of emission of oxides of carbon as well as the rate of deforestation.

Observations and Lessons Learned

The overall experience in rural electrification is not promising. The report - *The Socioeconomic Impact of Rural Electrification in Developing Countries* - written by the International Labour Organisation (ILO) concludes after reviewing over 150 documents-

> *".... the extension of electricity grids absorbs a considerable share of the development funds.... the benefits of extending grids to rural areas often tend to be overestimated and the costs underestimated. There is not much evidence to suggest that electricity .... had any major beneficial impact on the employment/income situation of the rural poor. On the contrary, there is some evidence of net job losses and worsening income distribution as a result of rural electrification."*

The Linking Rural Electrification with Rural Development in Asia report by ESCAP, after reviewing over 85 documents, has concluded that -

> *".... electrification does not seem to induce economic development unless it is treated as one element in a coordinated rural development effort. .... Electricity shortages can act as an important constraint to industrial growth. ...Irrigation pumping increases agricultural output and yield but dispersed pumps are expensive to electrify and grid electricity may often not be the lowest cost choice. ....the impact of rural electrification per se on the establishment of new industries and business has generally been modest."*

The Report of the Task Force on Rural Electrification Impacts in Nepal by the Water and Energy Commission Secretariat (WECS) concluded that -

> *"... in the past the impacts of rural electrification have been minimal....It does not mean there is no future for rural electrification. Rather it means that development of rural grid must proceed in a planned, reasoned way that accounts in a systematic way for the broader development goals..."*

Impending Issues

Market and Price Distortion

As long as price distortion prevails in the energy market, there is little scope for economically-justifiable energy options such as MMHP. Although the economic fuelwood price perceived by the nation is about NRs 2.5-3.5 per kg, 'free' fuelwood perception of the users will remain a major impediment in the development of MMHP in Nepal.

Lack of Capital Resources

Due to the lack of capital, cheaper traditional energy, which requires very little capital cost, is preferred in the rural areas to MMHP which requires much higher capital costs.

Low Load Factor

The average load factor of the rural electrification schemes in Nepal range between 19-23 per cent, and this does not generate enough revenue to cover the operational costs. The inability of MMHPs to serve the industrial sector, the fact that few in the rural population can afford them or their services, and other socioeconomic factors are the main reasons for the low load factor.

Technology R&D

The lack of policies to guide R&D activities in MMHP development has left R&D activities to the whims of organisations and donor agencies involved in their promotion. In order to use scarce resources sustainably, in a country like Nepal, R&D should be focussed on adaptive research rather than on fundamental research.

Private Sector Initiatives/Commercialisation

The role of private entrepreneurs is pivotal and needs to be further strengthened. The private sector needs to be promoted by the establishment of appropriate norms, standards, and support by the government.

Coordination and Promotion

In the absence of a coordinating agency solely devoted to activities related to renewable energy, either manufacturers or credit-funding agencies are carrying out the development and promotion-related activities in the MMHP arena. Integration is lacking, and most of the projects are formulated on an *ad hoc* basis.

Vision for MMHP

A three-pronged strategy is conceptualised to enhance the effectiveness of MMHP promotion.

Measuring Costs and Benefits

The existing distortions in the economic and market prices of energy must be internalised in carrying out the economic and financial analyses of MMHP so as to promote healthy competition, based on economic merit rather than on hidden subsidies. Additionally, the following measures have the potential for improving the viability of MMHP.

i) Improved rural development linkages
ii) Optimising design standards, costs, and reliability
iii) Encouraging local participation

Linking Mega-Project Development with Decentralised Energy Systems

Mega-power projects do not often envisage electrification of the project area. In such cases, the development activities associated with the project, which require additional energy inputs, may place tremendous pressure on forests for fuelwood. In addition to this, these projects can also lead to widespread resentment among the local people, along with negative socioeconomic and political impacts. Therefore, sufficient energy supplies must be made available in rural areas where large-scale hydropower projects are being considered for implementation. Additional energy supplies for the project areas could be made available through various decentralised energy programmes such as MMHP.

Enhancing the Economics of MMHP

For the reasons mentioned previously, it is unlikely that people will replace fuelwood with electricity without external intervention. These interventions could be in the form of education and awareness, reduced electricity tariffs, increased employment opportunities, and diversified use of electricity.

Electricity has the potential for substituting fuelwood in agro-and forest-based cottage industries as well as replacing human labour in agroprocessing activities and other income-generating activities.

End-use diversification, together with appropriate energy pricing, will also help to improve the load factor of the MMHP system and thereby reduce the cost of electricity. The following cases illustrate the implications of such diversification activities.

Case 1: Five kg of green cardamoms can be processed by a one kW electric furnace operating seven hours a day (0.025 GJ) and replaces 6.26kg of fuelwood (0.105 GJ). In other words, a 20kW capacity micro-hydro unit can process six tons of cardamom in two months and save 7.5 tons of fuelwood.

Case 2: A 10kW micro-hydro unit can reduce the human toil of 100 households in agroprocessing substantially and, thereby, increase the labour available for other activities.

Promoting the Role of the Private Sector

The credit for developing micro-hydro in Nepal goes to the active leadership and sustained promotional activities of the Agricultural Development Bank of Nepal (ADB/N). Need-based development of micro-hydro technology is due to the efforts of private manufacturers and entrepreneurs. The issues that must be dealt with in order to make private sector participation more attractive can be outlined as follow: (i) provision of management, financing, and training; (ii) identification of the role of the private sector; (iii) standardisation of technology; and (iv) an appropriate incentive package for manufacturers.

Concluding Remarks

The provision of mechanical/electrical energy can act as the catalytic agent for rural development if 'other' development inputs and needs are coordinated. Provision of electricity is not enough to facilitate rural development but need-oriented approaches to rural development, linked with the provision of energy, could provide opportunities for local initiatives. The absence of either component will decrease the potential of long-term sustainable growth, although marginal economic benefits from local electricity may be realised initially.