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Introduction

Shortage of energy is a serious constraint to the achievement of sustainable development. Predominant dependence (95%) upon traditional energy sources such as fuelwood, agricultural residue, and animal wastes characterises the energy scenario of Nepal. Among traditional energy sources, fuelwood constitutes 75 percent while dung and agricultural residue share 11 percent and 8.5 percent respectively. Poorly managed forests have to shoulder this immense burden to meet the increasing demand for energy caused by both the rising population and the lack of development of alternative of alternative energy resources.

It is ironic that Nepal, endowed with one of the largest hydropower potentials in the world, that so far less than one percent of its existing potential is only tapped. Thus, the search for and production of alternative options to meet energy needs is of paramount importance.

One of the alternative sources of energy for cooking in the rural areas is biogas. Nepalese agriculture is dominated by a mixed farming system in which crop and livestock husbandry are combined. This necessitates that every household maintains a few animals. The livestock population in Nepal is estimated to consist of 3.4 million cows, 3.6 million oxen, and 4.2 million buffalo. The daily average production of manure is 10 kg per animal. Thus, theoretically, the establishment of 1.8 million family-size biogas digesters is possible. Practically, it is difficult to collect all the dung, and assuming the use of only 60 percent of the total production of dung, the potential number of biogas digesters required would then be about one million.

The time involved in collecting fuelwood or making dung cakes is enormous, and if farm families are relieved of this operation they could use the spare time for other productive and income-generating activities. To achieve this, it would be necessary to provide fuel for cooking and illumination to each rural household at a cheap rate.

It has been known that, as the dung passes through biogas digesters, the resultant slurry is enriched with nutrients. Thus, theoretically, the slurry would yield a higher quantity of nitrogen, phosphorous, and potash than the actual dung. Unfortunately, because of a shortage of fuelwood in the Nepalese Terai, most of the fresh dung is converted into dung cakes for cooking and thus the agricultural land is deprived of traditional farmyard manure.

It is thus seen that biogas technology has enormous potential for meeting the demand of fuel for more than a million households in Nepal. Tangibly, it could replace the use of some petroleum products as well. It will also relieve rural women of the hazardous task of fuelwood burning and of physical hardships caused by several hours of travel each day in search of fuelwood. Biogas technology, therefore, assures wide ranging socio-economic benefits for the prosperity and the quality of life of rural households. As rural households switch to biogas for cooking, their predominant dependency on fuelwood for cooking will gradually decline and this will certainly ease the burden on the depleting forests. There is also a potential for employment generation during the construction and establishment of these plants and their subsequent maintenance training by the company. This means that the direct involvement of the company will be in the construction of larger biogas plants (more than 15 m^3) and the smaller ones will be contracted out to private firms. The company will provide supervision and monitoring to ensure that biogas plants are installed properly.

The Biogas Company expects to remain the lead agency in the development and dissemination of biogas in the country, by providing support to private individuals and firms engaged in the promotion of biogas. It plans to enlarge its activities in research and development to reduce the cost of plants and find alternative uses for biogas and slurry. The feasibility of producing electricity form biogas is being examined as well as the use of slurry for animal feed. Thus, given a government favourable policy, the combined efforts of private sector, the Biogas Company, the

Agricultural Development Bank of Nepal, and the United Mission to Nepal could contribute significantly to the development of biogas in Nepal.

Problems and Prospects: Issues for Discussion

1. The Government does not have a consistent policy for the promotion of biogas to meet energy needs. This is reflected in the *ad hoc* nature of its subsidy policy. Therefore, it is now high time that the Government makes a firm policy commitment in this area, in particular, and towards the development of renewable energy resources, in general.
2. There is no specific department or ministry responsible for promoting the development of renewable energy resources. At present, several departments and ministries are engaged in promoting different energy technologies but their efforts are not co-ordinated rendering it hard to identify one institution to plan and implement renewable energy policies. Since activities are uncoordinated and isolated; there is no systematic future plan or direction. It is important to make a specific department in the development responsible for the development of renewable energy resources.
3. The initial installation cost of existing biogas designs is high and beyond the reach of the majority of rural families in Nepal. Research into more cost-effective designs is essential if biogas is to be accessible for poor households as well.
4. Low gas production during the winter months, particularly in the colder hilly regions, has been a constraint to the promotion of biogas in the hills and mountains. Research is needed to explore appropriate methods for maintaining higher temperatures in the digester pit, so that optimum gas production can be ensured throughout the year.
5. There is very little publicity, particularly of the audio-visual kind, and a better extension and dissemination programme is essential.
6. There is an insufficiency of trained manpower to build, supervise, and repair biogas digesters. Training at different levels is essential.
7. Construction materials such as cement, G. I. Pipes, biogas lamps, and other appliances are unavailable in some parts of the country. They are also difficult to transport to the remote hilly areas. Transportation subsidies will be necessary if biogas plant installation in inaccessible areas is to be promoted. Here again, a definite government policy is needed to assess the amount of subsidy required.
8. Community biogas plant construction has not been successful in many places, but why it failed is unknown. Can such community biogas plants be promoted to enable poor householders, who cannot afford and maintain a small plant, to derive the benefits?
9. ADB/N has already taken a lead in the promotion of biogas. Other commercial banks should be encouraged to participate in the promotion of renewable energy resources.