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Development of Mini- and Micro-hydropower: Issues and Constraints

The availability of electricity is a prerequsite for improving the living standards of mountain populations. This paper establishes that mini- and micro-hydropower (MMHP) is the most appropriate energy option for remote and poor mountain areas. However, drawbacks do exist in terms of costs, management, operations, and repairs. MMHP can be made to be more productive and economically viable through proper training, management, and design.

The Context

The development of mountain areas has lagged behind that of the plains in the developing countries, especially in the Hindu Kush-Himalayan (HKH) region. While there may be some exceptions, e.g., parts of Himachal Pradesh (India) and Swat District (Pakistan), the overall picture depicts a lack of basic necessities such as drinking water, roads, and health facilities. The unavailability of appropriate and adequate energy sources adds to the seriousness of the problem by not only adversely affecting the living conditions of the people but also hindering development endeavours and prospects. Lack of such sources usually also results in damage to the environment through excessive and unsustainable use of fuelwood and other biomass.

Provision of electricity to the whole population in the countries of the HKH region is a declared and long-standing goal of the respective governments of the region. However, the achievements fall far short of the declared goals and plans in this respect.

In Nepal, less than five per cent of the rural population has access to electricity. Even in Himachal Pradesh, which is the most advanced mountainous State in India, and where it is claimed a 100 per cent of the population receive electricity, 14 per cent of the rural population was still without electricity according to the 1991 census results.

It is known that the availability of electricity alone in a given area does not necessarily bring about an increase in income-generating activities or small-scale industries. Additional efforts have to be made and inputs provided to trigger activities that meet the desired objectives. Nevertheless, provision of electricity for normal consumption, such as lighting, does contribute towards the increase in productivity, mainly because of the availability of additional working hours. Some perishable goods can also be preserved and/or processed by using electricity. Electricity also improves living conditions, since it is a much better source of light and provides recreational opportunities.

Electricity is no longer regarded as a luxury but a necessity, even in the most remote and underdeveloped areas.

The main drawbacks in remote mountain areas are poor transportation and communication facilities, abject poverty, lack of modern technology and devices, and a scattered population. Therefore, it is necessary to select appropriate and cost-effective options for providing energy. In most cases, grid extension is not feasible, neither economically nor technically. Therefore, usually, local and small-scale options are considered for such areas; e.g., diesel-powered generators, mini- and micro-hydropower (MMHP) plants, solar photovoltaics, and wind generators. Out of these, MMHPs, especially in the micro-range, are considered to be the most viable, cost-effective, and environmentally-friendly, although some drawbacks do exist. The main amongst them are higher capital costs, more land requirement, and specific locations that may not be suitable from the point of view of business. Diesel plants, on the other hand, can be located and relocated anywhere quite easily.

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Comments are Welcome

The Barpak MHP Plant - A Success Story

Bir Bahadur Ghale, a young entrepreneur from Barpak village in Gorkha district, Nepal, decided to install an MHP plant in his village in 1989. The village is about one and half days' walk from Gorkha, a small town in the mid-hills of Nepal. Bir Bahadur eventually ended up investing almost half a million rupees of his own money to complete a 50kW MHP, after receiving a subsidy and loan from the Agricultural Development Bank of Nepal (ADB/N). The total cost of the plant was Rs 2.48 million, and it was commissioned in 1990. After a lot of trials, mishaps, and problems, Bir Bahadur now sells almost all the electricity he generates during the evenings and supplies it to four enterprises during the day; these include a paper-making factory, a furniture workshop, a bakery oven, and a grain mill. The first two enterprises are owned by Bir Bahadur and the last two are not. By the end of 1995, it was estimated that Bir Bahadur was earning more than one million rupees a year from the sale of electricity and from the two industries he owns; which is quite a good return on the total investment of about 3 million spent in setting up the power plant and the industries.

Barpak is an out of the way sleepy village, not normally frequented by tourists; however the average income of the villagers is high because many men serve in different armies, including the British Gorkhas. Bir Bahadur is an ordinary young man who did not have any technical knowledge in the beginning, let alone about hydropower generation; but he has learned a lot in this respect during the past five years. He is going to install another 40kW MHP plant downstream of the first one and planning additional industries, including a metal workshop.

Costs and Incomes

Despite the above drawbacks, MMHP plants are more viable economically on the basis of 'life-cycle costs and returns', because no fuel is required and MMHP plants are usually much more durable than diesel plants. Another advantage is that micro-hydropower plants (MHP- up to 100kW capacity), being simple, are relatively easy to maintain than diesel engines.

It is a known fact that, private MHP plants producing only electricity, are not earning adequate net incomes. In fact, very few have net incomes that are enough even to take care of the normal repair works. Therefore, it is generally advised that the level of use of the available potential power should be increased considerably; especially for providing power to income-generating end uses. This can be done by direct mechanical coupling or through electrical transmission to run agro-processing units, saw mills, or other similar establishments. It is necessary that such plants earn adequate income for entrepreneurs to consider them worthwhile. There are many examples in Nepal and elsewhere that show that this is possible and achievable.

Indigenous or Imported Equipment ?

It is generally advised that MHP equipment should be manufactured locally; because it is much cheaper than imported types. However, almost always, the quality of the locally-produced equipment is poorer than imported machinery resulting in low efficiency, frequent breakdowns, and a shorter life-span. All this contributes towards less economic returns and benefits.

Nevertheless, after taking into account other related aspects, it has usually been advocated that indigenous development and/or manufacturing of the equipment is a better option. These aspects include contribution towards the development of a local technological base; improved awareness about scientific and technological solutions leading to improvement in living conditions; higher costs of spare parts for and repairs of imported equipment; and relative ease in mastering the operations and maintenance of locally-produced equipment.

Questions may be raised concerning whether the development and manufacture of indigenous equipment should be adopted in the less developed countries or whether more reliable, sophisticated, and expensive equipment should be imported.

However, in order to sustain this point of view in the longer run, it is necessary that the quality is continuously improved and the costs remain fairly low in relation to imported machinery. Improvement of quality and performance will also lead to improved benefits and economic returns, which are fairly inadequate at present. Efforts on the part of implementers, manufacturers, and promoters are essential in this respect.

Management and Operation

Another often reported problem is inadequate management and operational capacity. Usually, managers and operators are not educated and not conversant with the

MHP Plant in Lali Village, Darchula District - A Not So Successful Story

Many private MHP plants in Nepal have failed due to a number of reasons. The plant of Mr. Prajapati Ashwati in Lali Village of Darchula District is a typical example.

The owner was quite enthusiastic about the plant when it was completed in 1985. A 7kW turbine was installed to provide power for a generator, a grinder, a cotton ginning unit, and an oil expeller. The total cost was 335,000 rupees. Initially, everything seemed to go well; the plant had net earnings of about Rs 40,000 a year and the villagers were proud to have electricity since the other part of the village on the Indian side of the border did not have any.

Then, some additional MHP mills were installed in nearby villages, resulting in less business for the Lali mill. After about a year, the generator broke down twice in about two months and was never repaired again (the repairs were to be carried out in Butwal by the original installers). The canal also kept breaking down during the monsoons. The agro-processing operations continue sometimes, but enthusiasm has dissipated since the plant never made enough money and the repairs, which were needed quite frequently, had to be carried out in a very far away place.

technology, or even with business practices. In fact, some studies have suggested that the main cause of the poor operational and economic performances of some private MHP plants has been poor management. Sometimes the managers may even lack the aptitude and stamina required for properly managing such ventures which involve technology, business aspects, and public relations; especially when things go wrong (a very likely prospect!). Therefore, some experts have even suggested a level of capability assessment of prospective entrepreneurs and managers before, say, approving the funding. Even then, it will be necessary to improve the capacities of the managers through adequate training, information manuals, and occasional backstopping and advice. Similarly, operators need to be trained and supervised and advised in the form of on-the-job training. Some level of training is already provided to the operators during the installation and commissioning phase. However, this training has not been adequate.

Repairs and Service Centres

Undertaking repair work is another serious issue concerning private MHP plants, especially in the more remote and inaccessible areas. The main problem is lack of repair centres and absence of competent technicians in the vicinity of the plants. Heavy machinery or parts of machinery have to be transported for days, usually manually, to take them to the original manufacturers for repairs. Sometimes, it may be necessary to take a mechanic from the manufacturer to a far-off location to dismantle a damaged machine. For manufacturers, such endeavours will not be lucrative. Excessive delays have been reported in both these aspects. In some cases, the plants have remained closed for three months or more.

Adequate training and information for managers and operators will not only enable them to locate and assess the damage but will also help them prevent it through proper operation and maintenance procedures. They may also have adequate knowledge and skills to disassemble a machine, remove a component, examine the damage, and take it to the repairers. But the more serious problem is lack of appropriately-located repair centres. Some novel ideas are currently being tried out in Nepal in this respect. These include formation of a club of a number of plant owners in an area (say a watershed or a valley) to establish a repair centre; assistance to a local technician to establish a small workshop in addition to his receiving training; and the establishment of a repair and service centre by a manufacturer, or promoter, to be handed over to a local technician/employee. However, it is too early to say which of such initiatives will be more effective and self-sustainable in the long run.

The issues discussed above are considered to be most pertinent in the context of private MHP development in the more remote mountain areas. There are other constraints and issues such as lack of institutions and resultant support, inconsistency of programme funding and procedures, and the lack of standardised designs and testing facilities. However, if some progress can be made in the context of the four issues discussed above; many (perhaps most) of the problems being faced by the private MHP sector could be resolved.

It is believed that through proper, up-front training, user manuals, and backstopping, MHP plants can become more reliable, productive, and economically viable.

Highlights of ICIMOD's Contribution

Past

- Collected and analysed information about the achievements, problems, and prospects of private/decentralised MMHPs in the HKH region.
- Brought together planners, decision-makers, experts, promoters, and implementers to review various issues related to MMHP and to recommend actions for further improvement.
- Organised networking to facilitate contacts and exchange information and expertise available within the region.

Present

- Building upon information and analyses through in-depth studies, sample surveys, and data gathering.
- Building capacities through training programmes, information manuals, and study tours.
- Improving policies and programmes through consultation and advice.

ICIMOD's Intervention

ICIMOD has been actively engaged in promoting MMHP plants in the HKH Region as a viable and eco-friendly source of energy for meeting the different energy needs of remote, inaccessible, underdeveloped and sparsely-populated mountain areas.

Because of its important advantages, ICIMOD has been working at various levels to generate support for MMHP; e.g., at the planning and policy level through interaction with governments and international agencies; at the implementation level through improving the capacities of implementing agencies; and at the field level through training programmes, training materials, and in-depth studies.

A sample survey to learn about the functional and economic status of existing private micro-hydropower plants was designed and is being carried out. Suitable agencies in three participating countries, namely, India, Nepal, and Pakistan, were identified and their past work, achievements, and future needs, particularly in terms of training and output improvement, were assessed. Cooperation with them will be strengthened. A number of individuals and organisations has been identified in Nepal to prepare five information manuals on various aspects of MMHP development for various groups; including surveyors, installers, manufacturers, managers, operators, and repairers.

Thus ICIMOD has been advocating at various levels and providing inputs for the enhanced use of MMHP; believing that it can contribute to the Centre's dual mandate of poverty alleviation and environmental conservation in the HKH.

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Further Readings

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Established in 1983, ICIMOD is dedicated to the cause of poverty alleviation and environmental conservation in the Hindu Kush-Himalayan range of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. ICIMOD is a focal point for documentation and information exchange, training, applied research, and demonstration on a wide range of issues affecting mountain people.

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