PRACTICAL ACTION
Technology challenging poverty

COOK ELECTRIC
THE GHANDRUK EXPERIENCE

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We all recognize the central, life-sustaining importance of food, water, shelter and clothing. Energy, because it is less visible, is often overlooked, yet it is the driving force behind everything we do. Energy is fundamental to development because it allows people to do more with the resources they have. This is why reliable and accessible energy supplies are so important in enhancing the lives of poor people.

Using the example of Ghandruk, a mountain village in Nepal, this booklet describes how one form of energy - micro-hydro power - can help rural communities meet these needs. It also demonstrates how this power can be used for electric cooking, and the implications this has for saving fuelwood.

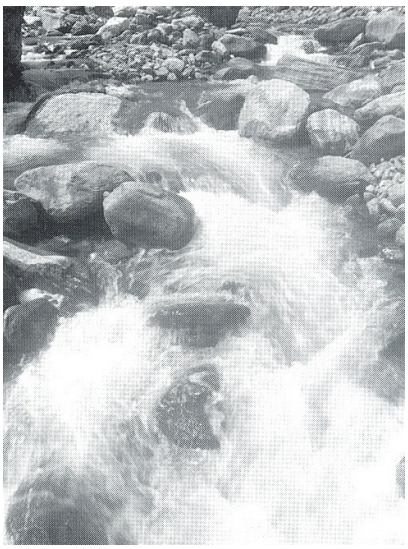

Figure 1: Water is one of Nepal's most valuable natural resources.

Background

Nepal faces a number of challenges in meeting its energy needs. A poor country, land-locked in the centre of Asia with no fossil fuel reserves of its own, it cannot afford to depend on expensive imported fuels. Partly because of this, and partly because much of the population lives in isolated mountainous districts, about 90 per cent of Nepal's energy consumption comes from 'biomass' fuels (mainly firewood, but also dung and other combustible natural materials). The steady increase in population, coupled with other factors such as the recent explosion in tourism, means that these resources are now being stretched to their limits.

But the country is rich in one important resource: water (hydro) power. Nepal has the potential to generate nearly 30,000 megawatts (MW) of power from its fast-flowing rivers that thunder down from the Himalayas. Even in a power-greedy industralized country this would be a massive resource - enough, for instance, to run Britain's two largest cities, London and Birmingham, where around eight million people live and many more travel daily to work.

The Government of Nepal has recognized this potential and the country's hydropower sector is developing rapidly. Medium- and large-scale schemes are the main focus for providing power for the national grid. Yet only 10 per cent of Nepal's 19 million people have access to grid electricity. In view of the country's mainly mountainous terrain, extending the grid to reach these people will be slow and costly.

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Micro-hydro power

Decentralized, small-scale hydro systems could make power available to around 50 per cent of the population. Mini-hydro 000-1,000 kilowatts (kW)) and micro-hydro (up to 100 kW) schemes are now beginning to emerge all around the country, bringing power to villages which stand little chance of being connected to the grid. One of the main constraints to the further spread of such schemes is funding, as the cost of installation is expensive for rural communities.

Figure 2: A traditional Nepali water wheel or ghatta. More than 25,000 are still in use for milling grain.

Water turbines have been used to generate power for centuries in Nepal: the traditional wooden water wheel, or *pani gbatta,* is still used in most villages to grind grain. Micro-hydro technology aims to build on this traditional technique, making it more efficient and versatile. The flow of water is not interrupted by building dams, and so micro-hydro avoids the damaging environmental and social impacts of large hydro-electric schemes.

The energy generated by micro-hydro can:

- power machinery for hulling rice and oil expelling, saving thousands of women from the daily drudgery of milling by hand
- generate electric light, improving the quality of life in remote areas, which helps encourage people to stay rather than drift to the cities
- run electric cookers, saving trees and reducing the time spent collecting fuelwood, as well as improving safety and health support income-generating enterprises by powering machinery, thereby fuelling rural development

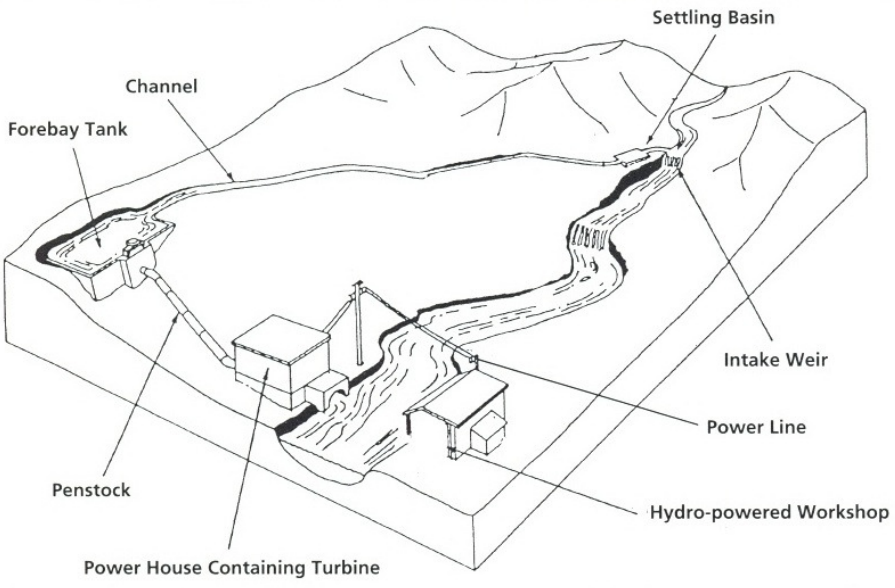

Figure 3: Diagram of a typical micro-hydro scheme. Water is diverted from the stream to drive a turbine.

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- allow communities to manage and control their own power supply.

There are now more than 800 micro-hydro installations in Nepal. Most of these are used for agricultural processing - such as milling grain, hulling rice or crushing oilseeds - but more than 100 also generate electricity.

Electricity is considered a major, and often the major, priority for development amongst rural communities.

This emphasis is reflected in the fact that during the general elections in 1991 and 1994 all the major parties adopted rural electrification as a central issue in their election manifestos.

The capacity to manufacture and install micro-hydro equipment is expanding rapidly in Nepal. Awareness of micro-hydro's great potential is also growing. Hydro schemes generating up to IMW have now been deregulated from Government control, so that more rural energy provision by setting up their own systems. communities are taking charge of their

Figure 4: Rice hulling machinery powered by micro-hydro.

Figure 5: Bijuli dekchi low wattage cooker, with instructions for use.

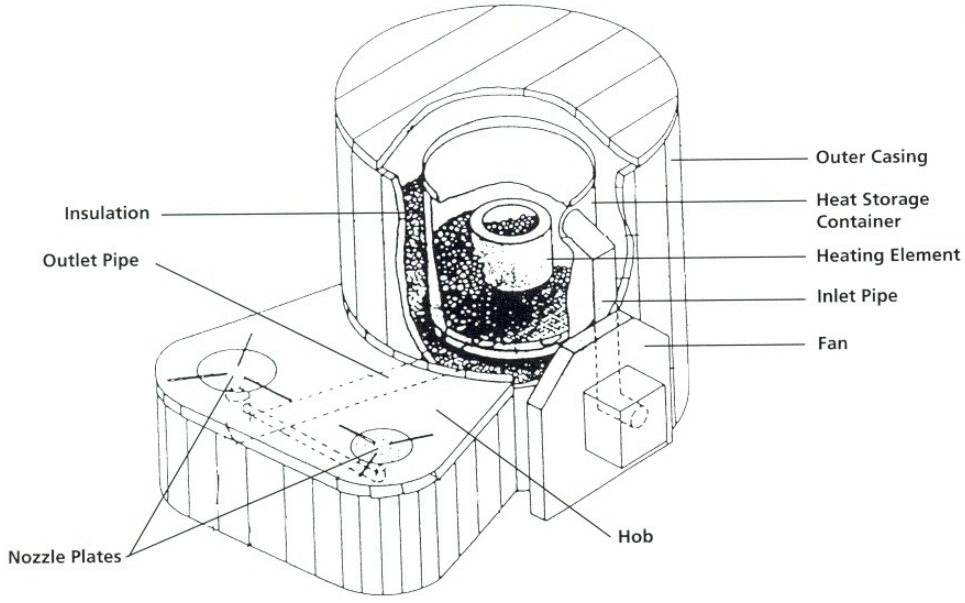

Figure 6: Cut-away sketch showing how the new heat storage cooker.

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Other countries inspired by the Nepal model, such as Sri Lanka, Vietnam, the Philippines and Afghanistan, are now starting work on hydro in their own rural communities.

Cook electric

Lighting is an important priority for most villages, but electricity can also be used for cooking as well as economic activities like grain milling, bakeries, dairies, and fruit and vegetable drying. Of these, there is particular interest in cooking, since this activity uses three quarters of Nepal's household energy. Electric cooking has the potential to reduce the pressure on increasingly scarce fuelwood supplies.

Since the existing electric cookers on the market are too 'power greedy' to be viable in most micro-hydro schemes, two types of electric cooker have been designed in Nepal with rural communities in mind.

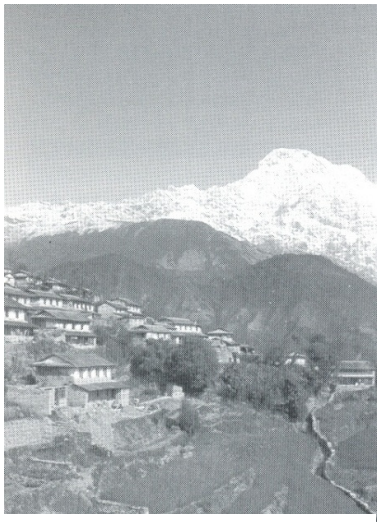

Figure 7: Gbandruk village, with Annapurna South in the background.

The *bijuli dekchi* consists of a cooking pot fitted with a low wattage element. It is used primarily to heat water, and also for cooking rice, lentils and vegetables. *Bijuli dekchis* come in a whole range of sizes (3-20 litres) and colours.

The heat storage cooker has an insulated block of pebbles for storing up heat from a low-wattage element. A blast of hot air from the heat store is directed at the base of the cooking vessel. Because its hob can be used for frying food as well as boiling water, the cooker may be a more appropriate choice in some districts, depending on local cooking practices.

Evidence is now accumulating to show that, in certain places and socio-economic conditions, electric cooking from micro-hydro can have a significant impact on people's lives and a beneficial impact on the environment. These findings have important implications for the future of energy generation not only in Nepal, but in many other countries as well. The story of the Ghandruk village micro-hydro scheme illustrates this clearly.

Ghandruk

The village of Ghandruk lies in the Annapurna region of Nepal, at the heart of the country's most popular tourist region. Perched upon a steep hillside above the roaring Modi Khola river, this tightly packed village of tall, stone houses is home to 270 families, most of whom are Gurungs. Although agriculturists by tradition, many Gurungs have joined the British and Indian armies over the years, establishing a reputation as the loyal and fearless Gurkha soldiers. Almost every household has at least one serving or retired army member.

By Nepali standards, the village is relatively wealthy because of income from the army, and in the last two decades trekking tourism has dramatically increased cash income for some families. In 1993 Ghandruk was visited by 7,000 tourists, and the numbers are steadily increasing. But agriculture is still the main occupation. Most families own land and are more or less self-sufficient in food: their main crops are rice, barley, millet, maize and potato.

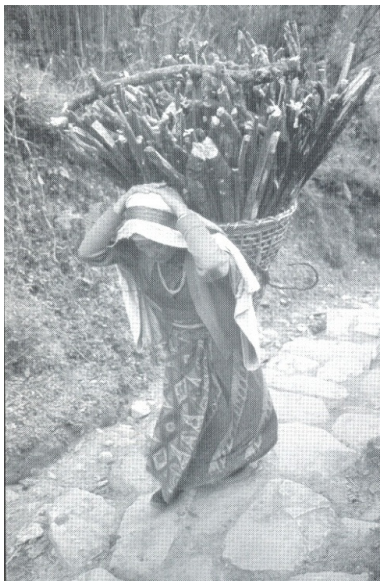

Figure 8: Gathering wood for fuel is laborious, and increasingly time-consuming as forest cover diminishes.

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Pressure on forest resources became an issue in the area when the pastoral traditions of the Gurungs - whose ancestors came down to Nepal's middle hills from the Tibetan plateau - gave way to settled agriculture. The growing population and, more recently, the arrival of tourists have increased this pressure.

It is not simply the increase in numbers that causes the problems. Tourists are 'hungry' for resources - particularly energy. The average tourist requires at least three times as much energy as a Nepali householder because of their demands for hot water and special kinds of cooking.

Recent decades have also seen the erosion of traditional social control mechanisms for resource management, or *rititihiti.* Forest resources and land used to be owned and controlled communally, and distributed according to family requirements. People grazed their cattle on a rotational basis, and collected fodder and fuelwood from particular areas at certain times. But the traditional systems failed to adapt quickly enough to keep pace with the rapidly increasing pressure on resources. A new approach to resource management was needed.

ACAP

Enter the King Mahendra Trust for Nature Conservation's Annapurna Conservation Area Project (ACAP). The project was established in 1986 to help communities meet the challenges of tourism and development without compromising the environment. ACAP's policy of 'conservation through development aims to keep people in the conservation equation, rather than trying to shut them out. ACAP adopted Ghandruk as its headquarters and began working with the villagers on a variety of projects including forest conservation, alternative energy, conservation education, health and sanitation.

From the beginning ACAP emphasized community participation, helping to set up village committees to oversee activities. Its work in the energy field began with forest management schemes: launching re-afforestation programmes, introducing a 'kerosene only' policy for the region around the Annapurna Sanctuary, where fuel wood was severely depleted, and promoting solar water heaters and back boilers in the tourist lodges.

Solar water heaters were only partly successful. They proved useful for hot showers, but are prohibitively expensive for many households and tourist lodges. Back boilers - which are installed behind the cooking stove and heat up water passively - were adopted more widely but still depended on firewood.

In the light of these developments and the increasing pressure on fuelwood resources, ACAP began - as part of its conservation activities - to consider the potential for electric cooking through the construction of a micro-hydro scheme. After detailed feasibility studies, work began on this ambitious project, which represented a major investment for the village.

The Ghandruk micro-hydro

The Ghandruk scheme generates power by diverting a stream that rushes past the village on its precipitous drop to the valley basin. This stream is no more than a metre wide in the dry season, but it generates 50 kW of power: enough to provide electric light for every house in the village, and for all the lodges and 20 per cent of families to cook with electricity.

Most of the equipment needed for the micro-hydro unit was made by Nepali manufacturers. It was installed by Development and Consulting Services, a Nepali non-

Figure 9: Villagers preparing a water channel at Sikles village, near Ghandruk. Community participation is an essential element of micro-hydro schemes.

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government organization that is promoting micro-hydro power. The British-based charity, Intermediate Technology, which has many years' experience in micro-hydro and Nepal, provided technical assistance.

Financial aspects

Micro-hydro schemes are very cheap to run and maintain once they have been set up, but they need considerable investment to start with. The 50 kW scheme cost Rs 3,590,000 (US$72,000) to build - working out at US$1,440 per kW installed. Large hydro schemes being built in Nepal for the grid cost two to three times as much per kilowatt.

Ghandruk village provided 30 per cent of the cost of the scheme, half of which was given in the form of labour and half taken as a loan from the Agricultural Development Bank of Nepal which has given similar support to a number of micro-hydro installations throughout the country. The remaining 70 per cent was provided in the form of grants and subsidy by the King Mahendra UK Trust for Nature Conservation, the Canadian Co-operation Office, and His Majesty's Government of Nepal; the funds were channelled through ACAP. A large grant was needed to make sure the project was sustainable and electricity was cheap enough to encourage electric cooking.

Figure 10: Electric lighting is one Of the main benefits brought by micro-hydro.

Electricity tariffs were set at a level sufficient to pay back the loan within five years, and to cover maintenance costs and salaries (three local people were trained to run the system). The tariff scheme was carefully designed so that the electricity would be affordable by all families in the village. Three different rates were set, so that commercial and industrial consumers subsidize the rates for domestic consumers.

Once the loan is repaid, revenue from the scheme in excess of that required to replace equipment will be invested in a Village Development Fund to be used at the village's discretion. In this way, the benefits from the scheme and the income from tourism can be spread more widely amongst the community.

Ownership and participation

Because of the high cost of installation it was critical that the Ghandruk villagers understood the commitment needed, and that they invested in, owned and managed the project themselves. To bring this about, a Village Electrification Committee was established, which was given responsibility for overseeing all aspects of the project, from construction to tariff collection.

Figure 11: Brewing tea on a metal tripod or agenu.

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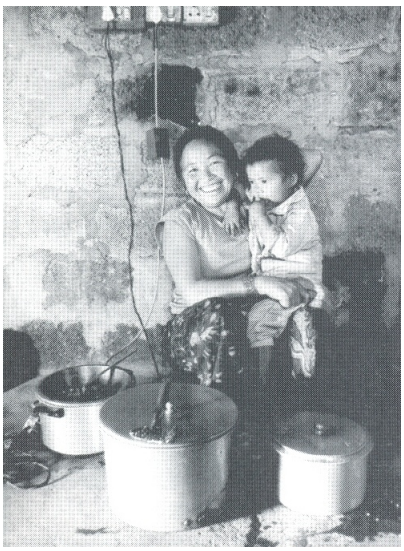

Figure 12: Bijuli dekchi in the kitchen.

Every family contributed labour to the project. This was vital not just for financial viability, but to make sure that the scheme was sustainable and that there was a sense of village-wide ownership. In return, each house was guaranteed electric light and the chance to subscribe to more power for cooking if they wished.

Labour contributions included porterage of materials, construction of the power house and civil works (the channels and tanks that the water flows through), and installation of machinery and transmission lines.

Impact

Ghandruk's micro-hydro now supplies every house in the village with electric light. Only 18 per cent of the households can afford to subscribe to electricity for cooking, and tourist lodges alone use one third of the available power. But the higher tariff rate paid by the lodges means that poorer families benefit from cheaper electricity. In this way, the income from tourism is spread more widely among the community.

Before the hydro scheme, families used between one and five litres of kerosene a month for lighting. To run one 25 watt bulb instead costs two thirds of the price of a litre of kerosene. As well as being cheaper, electricity provides better quality lighting, making it easier to do homework. Some children may not see this as a gain!

Lighting is not the only benefit of the scheme for poorer families. Many also save money on batteries for their radios and torches. Although radio and television are luxury items, their importance to rural communities should not be underestimated. Not only can they play an educational role, but access to such media can be influential in preventing the flood of youngsters to the towns and cities.

Similarly, the growth of economic activities made possible through the availability of electricity is increasingly important for rural development. In Ghandruk, power from the scheme is used to run a grain mill, which is many times more efficient than the traditional *ghattas.* A small bakery is being established as well.

Electric cooking in Ghandruk

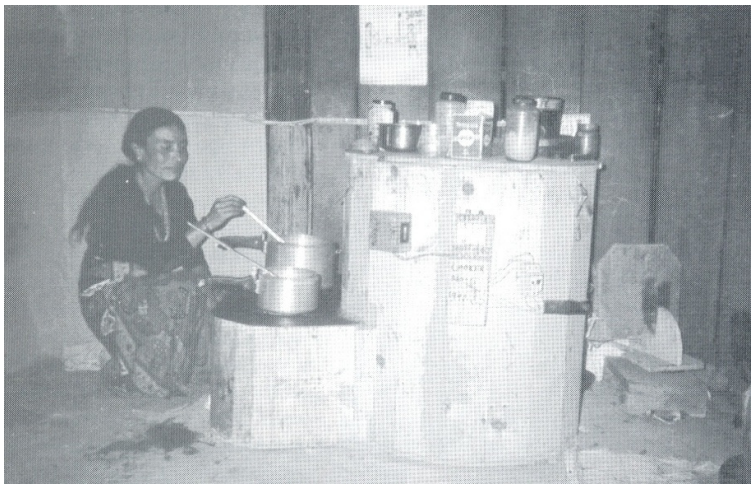

Figure 13: Heat storage cooker, with both hobs in use.

Most families cook with an *agenu,* a metal tripod placed in the hearth, and a *chulo* or traditional clay stove. Since electric cooking requires some adaptation of traditional cooking methods, ACAP recognized the need to promote electric cookers actively and offer advice on how to install and use them.

A revolving fund was set up to provide subsidies on

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bijuli dekchis to encourage people to buy them. The initial 33 per cent subsidy reduced cooker costs to US$13 an US$20 for the three- and eight-litre cookers respectively. ACAP's policy is to ensure that production and sales of cookers are sustainable in the long term, which means that subsidy levels are gradually being reduced on the *dekchis.* The largest 20-litre cookers, which are used almost exclusively by the tourist lodges, are not subsidized at all.

In the first two years of the programme, 85 cookers were sold in Ghandruk. The initial demand came mainly from the lodges, but over time interest from householders grew steadily, so that after three years equal numbers had been sold to lodges and houses.

The spread of the *dekchis* was stimulated largely by word of mouth, reflecting the satisfaction expressed by the users. Confidence in the cookers was initially low amongst women because they had very limited exposure to, and understanding of, new technologies. But once they were familiar with the cookers, they were only too keen to extoll their virtues.

A Ghandruk Family

Asha Gurung lives with her family in a typical two-storey stone house in Ghandruk. Her father is retired from the Indian army, her brother works for ACAP and she and her sister study at the school in the village. The family is largely self-sufficient in food, and they are able to sell a small surplus of maize and potatoes. They keep two buffaloes for milk.

The family uses a back boiler to heat water for bathing and preparing animal feed. Asha and her sister-in-law are responsible for collecting wood for the household. According to Asha, they need to go further to collect wood now than in the past. 'We spend nearly six hours every wood collection day - ten years ago it would only take three hours'.

The family uses electricity for lighting, cooking and for the television. Asha's mother, Budhi Kumari, was inspired to buy a *dekchi* after seeing a drama about it performed by a group of local women. They now have two *dekchis,* which they use for cooking rice and water. 'It is much more convenient for us to use the *dekchi* for heating water', says Asha. 'It is easy to handle and to clean, and the food tastes better from it. We just wish we had a larger one for when we have guests'.

The family uses nearly 15kg of firewood every day for cooking. Asha thinks the *bijuli dekchis* reduce their consumption of fuelwood by half. She says their fuelwood use has also gone down since the introduction of the television, which attracts many of their neighbours in the evenings. 'We tend not to sit around the fire for social chit-chats, so we use less wood now', says Asha.

The most important advantages are savings in cooking time and convenience, as a result of having a constant supply of hot water. Savings in fuelwood are also impressive. A study in January 1994 showed that 9 out of every 10 households using the cookers achieved 30-40 per cent savings in fuelwood use, and most lodges were saving nearly a *bbari* (30kg) of wood per day.

The advent of electric cooking has also resulted in increased use of Liquid Petroleum Gas (LPG) and kerosene in Ghandruk, because they are particularly suitable for fast cooking, using water already heated cheaply by micro-hydro power. Similarly, purchases of solar water heaters have increased. This is partly because the 24-hour availability of hydro-electricity provides a reliable back-up when cloudy days limit the use of the solar heaters. It is also in response to tourist preferences for lodges that do not use fuelwood.

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Keys to success

Three years on, all the available power from the Ghandruk scheme has been bought up, but demand has not been satiated. As a result, the villagers are now looking to upgrade the scheme to generate a further 50 kW of power. This is a clear indication of the success of the project. But it does not mean that the outcome would be the same in every Nepali village, or for similar schemes in other countries. The main keys to success in Ghandruk were:

- Expanding village economy. Ghandruk is relatively wealthy. Many families' cash income - from tourism, in particular, and the army - has grown. They could afford to pay for hydro power and the newly available electric cookers.
- Cultural homogeneity of the community. Nearly all the families are from the same ethnic group. Gurungs are sociable, friendly people and they live very close together, allowing a constant exchange of ideas.
- Status of women. Women have relatively high status and dominate domestic affairs. Their sociability has also contributed to the spread of electric cooking.
- Openness to new ideas. Exposure to tourism and army service has meant that the community is more open to new ideas than many more remote villages.
- Importance of tourism. Tourism contributes to the financial viability of the scheme. The demand tourists create for constant hot water enhances the benefits of the electric cookers. Moreover, by reducing trekkers' impact on forest resources the new energy source is helping to make tourism more sustainable.
- ACAP's involvement. ACAP has played a critical role in encouraging village-wide participation, offering technical advice, educating the villagers on conservation and development issues, and advising on management of the scheme.
- Competitive price of electricity. Since electricity from micro-hydro has to compete with 'free' fuelwood, it must be cheap in comparison to other sources.

Implications

The Ghandruk project is an important test case for demonstrating the viability of electric cooking in rural communities. The Ghandruk experience has shown that the benefits of electric cooking are convincing enough for richer families to justify the investment, and to cause people to modify their cooking habits. The main obstacle to spreading electric cooking further is its affordability.

As we have seen, electric cooking has led to significant fuelwood savings for individual families. But these savings will not make much of an impact on forest resources. This is because at present only a minority of families cook with electricity, and because there are other demands on fuelwood supplies. While fuelwood remains cheap or free and is easy to obtain, electric cooking is unlikely to be financially attractive to villagers. But in areas where fuelwood is scarce, it is already a competitive option. As pressure on fuelwood increases throughout Nepal, the niche for electric cooking will grow steadily. In the meantime, the promotion of electric cooking will require considerable financial support and subsidies.

It is the power needs of the future - not just the present - which make electric cooking so important. The market for electric cooking may be small now, but it will grow steadily, since economic growth goes hand in hand with dramatic increases in energy consumption. As the standard of living rises, so too will the power needs of villages. Micro-hydro offers a relatively cheap, reliable and sustainable way of meeting these needs and fuelling rural development. There may not be enough demand in many remote Nepali villages to make micro- hydro viable now, but the situation is likely to be different in a few years' time.

The potential for micro-hydro in other countries may well be even greater. Nepal's per capita fuel consumption and income are amongst the lowest in the world. Many other countries with micro-hydro potential are more able to afford the investment required. The surge of interest in Nepal's experience from Asia, Africa and Latin America seems to bear this assumption out.

Further information

If you would like to know more about micro-hydro and its potential, you could contact:

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Written by Janet Bell. Edited and produced by Practical Action (formally ITDG), December 1994.

Acknowledgements

Practical Action wishes to thank the Overseas Development Administration and Glaxo Holdings plc for their financial support to its work on electric cooking in Nepal.

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