POWERING DEVELOPMENT

ENERGY FOR THE RURAL POOR

MICHELLE HIBLER

Almost a decade has elapsed since the energy crisis first captured the world's headlines. But in the developing countries, the crisis began long before the fourfold increase in the price of oil in 1973-74 and has been felt with much more immediacy than in the industrialized world.

Today, in fact, developing countries still only account for less than one-fifth of world commercial energy demand, mainly for their industrial and transport sectors. Up to 40 percent of their energy needs are met by fuelwood and other noncommercial sources — agricultural wastes, animal dung, etc. For these countries, the energy crisis means the growing scarcity of traditional fuels rather than the scarcity of oil. For their populations, the major energy problem is simply finding enough wood each day with which to cook.

The World Bank's *World development report 1981* states that "the two critically scarce fuels in the 1980s are oil and fuelwood." According to a recent FAO survey, more than 100 million people cannot obtain sufficient fuelwood to meet their minimum needs right now. And supporting World Bank statistics reveal close to 70 developing countries have a fuelwood shortage, or will have by the end of the century.

The problem is by no means new in many parts of Africa, Asia, and Latin America, where population growth and the need to clear land for agricultural use have long put pressure on forests. But the scarcity is now exacerbated as the higher prices of conventional energy raise the demand for traditional fuels, especially charcoal, in urban areas.

In many densely populated countries, forests have shrunk dangerously. The use of wood is greater than sustainable forest yield in several countries; and in many more, deforestation is a serious problem because fuelwood cannot be transported economically over long distances.

As forests disappear, people in rural areas must spend more time collecting fuel, often at the cost of working the land for food production. The poorest are the worst affected since they can least afford to buy fuel. In parts of Africa, people have been reduced to eating only one cooked meal a day.

As wood becomes scarce, people burn more dung and crop wastes that could be better used as fertilizer. The United Nations estimates that this lost fertilizer could provide an additional 20 million tonnes of grain a year. A vicious cycle of depletion, soil loss, lowered crop production, lower incomes, and, hence, greater dependence on "free" fuels like firewood is created.

Environmental problems also ensue. When trees and other vegetation are removed, the soil is eroded and riverbeds and canals silt up. Deforestation also reduces the earth's capacity to absorb the extra carbon dioxide caused by burning fossil fuels.

One-quarter of the world's land surface is now forested, but this is expected to drop to one-fifth by the end of the century. Although deforestation is not a new problem, the rate of destruction is unprecedented (see *Reports* 10 (1), April 1981) and has reached alarming proportions in the Third World. For developing countries as a whole, forests are likely to shrink by 40 percent in the next 20 years.

In recognition of this fact and seeing no viable substitutes for fuelwood in many regions of the world, the United Nations Conference on New and Renewable Sources of Energy (UNCNRSE), held in Nairobi in August 1981, adopted a resolution calling for the immediate acceleration of reforestation and afforestation programs. The goal would be to achieve a fivefold increase in annual tree planting rates by the year 2000.

Other recommendations at the conference included improved distribution of fuelwood plantations, improved conversion technologies, and the use of more and better wood-burning stoves.

Firewood was only one source of energy considered at UNCNRSE. In the energy mix that could be applied to developing countries, solar and wind power have a great deal of potential. Using presently available technologies — some of which have changed little for centuries — they are already economic alternatives in some applications such as crop drying, small-scale electricity generation, and water pumping.

Of the various energy-harnessing technologies considered, only hydroelectric power was considered to be "fully mature" and is expected to be the major energy growth area in the near future. Some 16 percent of the world's potential hydroelectric power is currently used, providing 23 percent of the world's electricity. Developing countries have about half the world's potential, but so far only nine percent has been exploited, supplying electricity to only 12 percent of their population. Small-scale hydro projects could allow these countries to exploit their abundant waterpower resources for the benefit of rural populations.

The Programme of Action adopted at the conference calls for efforts in five broad policy areas: energy assessment and planning; information flows; research, development, and demonstration; transfer, adaptation, and application of mature technologies; and education and training.

These priorities are echoed in IDRC's energy research program. Of the Cdn $40 million of allocations to energy activities announced at UNCNRSE by the Prime Minister of Canada, Pierre E. Trudeau, $10 million will be channeled through IDRC over the next four years, beginning in April 1982,in support of energy research related to developing countries.

IDRC is not a newcomer to the field of energy research. Some 50 projets involving energy research have been supported in the past 11 years throughout the developing world, at a cost of some Cdn$7 million. They include rural energy surveys, studies of national energy policies, technology assessments, experimental fuelwood plantations and biogas generation plants, and the design of small postharvest technologies. A few of the projects are described on these pages.

Under the expanded program these activities will continue and new initiatives will be undertaken. There will be increased support for research in forestry and on fuel-related aspects of postharvest technologies. A new subprogram will be created to support research in developing countries on energy policies, and the information requirements of developing areas will be examined. The Centre's Cooperative Programs Unit (see *Reports* 10(4), January 1982) will review the prospects for collaboration between Canadian and Third World scientists, including cooperation on the development of technologies.

The most significant of the proposed new initiatives will be the creation of a research advisory group, the Energy Research Group (ERG). Composed of

Engineers in Egypt test an experimental solar dryer. The sun is one of many noncommercial sources of energy that could be exploited in rural areas of the Third World.

eminent researchers and policymakers from developing countries, the ERG will review energy research needs, priorities, resources, and technologies in the energy sector to assist developing countries to develop their own strategies. IDRC also intends to strengthen communications between donor agencies active in energy research.

The transition away from the dominant use of oil into a new sort of energy mix will not be easy, nor will it be cheap. Most experts agree, however, that it can be done.

But just as new and renewable sources of energy cannot be viewed in isolation from an overall energy approach, energy problems and projects cannot be separated from the environment in which they occur. And as Enrique Iglesias, Secretary-General of the UNCNRSE, points out: "It would be a tremendously misleading policy to divert attention from the real and most essential element — development. ... Alternative sources of energy are only tools for achieving that end." □

A COOL STRATEGY

Known as the Golden Triangle, the mountainous northern region of Thailand, the Shan Plateau in Burma, and an adjoining area of Laos are the source of most of the world's illicit opium. Chasing the dragon there (as efforts to eliminate the drug trade are called) through law enforcement and destruction programs has proven so difficult as to be virtually ineffective. Less than five percent of the opium is intercepted.

For the impoverished hill tribes that grow opium poppies, the crop provides income, security, and medicine — needs that could be met in other ways. That is the thrust of a displacement strategy formulated by the United Nations Fund for Drug Abuse Control (UNFDAC) and the Thai government's Royal Northern Project. They hope to encourage the production of various fruits, vegetables, and flowers as cash and food crops on land where poppies now grow.

Political pressure — particularly from industrialized countries with drug abuse problems — to stop the trade at its source is growing. Poppy production has also resulted in severe environmental problems in Thailand. It is estimated that 20-40 000 hectares of land have been eroded as a result of deforestation and soil depletion by poppy growers who strip the land and then move on.

Cool storage for the replacement crops may be critical to the success of UNFDAC's strategy. Extending the stored life of the fruits, vegetables, and flowers will allow more flexibility in marketing, holding stocks until prices are good. Cool storage would also maintain the products' quality, thus commanding better prices, and would allow the consolidation of loads for better fuel economy when trucking to markets.

With support from IDRC, the Faculty of Engineering of Chieng Mai University has set about to develop a low-cost, rugged, simple-to-use passive solar cooler for the program. Set into the hillsides to take advantage of the earth's insulating properties, the cooling chambers will be essentially large (5 x 7 x 3 metre) radiators. A water reservoir fitted with conducting fins that extend into the chamber's interior will act as a heat sink, drawing heat from the room and radiating it into the cooler air at night. During the day, an insulating cover will prevent heat gains. Dr Piyawat Boon-Long, the principal researcher, calculates that it will thus be possible to maintain the temperature inside the chamber at 5-10 °C below outside air temperatures. The resulting storage temperatures of about 15 °C in summer and 10 °C in winter will be cool enough to meet storage requirements of many of the new crops being introduced.

Proper storage techniques and the keeping qualities of various commodities will be determined. The researchers then hope to study the social and economic conditions that would influence the successful adoption of a passive cooler.

Rowan Shirkie

SAHEL FOREST ENERGY

With the disappearance of natural forests in many parts of the Sahel, the firewood shortage has become acute, particularly in highly populated areas. To help solve this problem, the government of Niger requested IDRC assistance in 1973 in carrying out a project aimed at producing firewood and utility lumber by establishing village woodlots.

In three regions in the south of the country — Myrria, Magaria, and Matamèye — nurseries were established to produce seedlings. Various seed-growing techniques were tested and improvements made. At Matamèye, the researchers from the Water and Forestry Services of the Ministry of Rural Development developed an innovative sand and plastic sheeting capillary watering technique for germinating beds that proved highly successful.

Simple techniques were also developed for brush clearing, stump removal, and surface soil preparation. Planting trials showed that a good survival rate and rapid growth of seedlings could be achieved if a hole 60 centimetres square by 35 cm deep was dug around the plants. Good success was also obtained in some plots using the fishbone technique: Earth is mounded on the downhill side of the hole to create a basin. Trenches link this basin to two others, thus creating a terracing effect. Erosion is prevented and maximum use is made of rainfall.

Experiments with the *taungya* method — growing food crops between the trees — also proved successful and taught the peasants that trees and food crops could be grown together.

The best results were achieved in the Matamèye region where 31 villages participated in foresting 80 hectares. More than 90 percent of the trees survived. Around Magaria, 21 villages planted 55 hectares with a survival rate of 60 percent. Unfortunately, the results were not as good in Myrria where conditions are much more difficult.

A total of 165 hectares were planted in 59 villages. Of the 20 exotic tree species introduced, the Neem (*Azadirachta indica*) and *Eucalyptus camaldulensis* had the best survival rates.

The first plantations established in 1974–75 are now awaiting exploitation, due to begin in May 1982. The peasants will decide on how they are to be cut, and will reap the harvest.

Technicians have now launched a second phase of the project in nine villages around Matamèye. The testing of indigenous and exotic tree species will continue and simple methods will be developed for producing plants and planting trees in stands and scattered in farmers' fields. Villagers will then be taught the most appropriate techniques to ensure that they can continue the work by themselves.

Abdoulaye Boureima

TAPPING BIOGAS

Methane generated by fermenting animal, human, and agricultural wastes has been a source of household cooking and lighting energy in rural areas for many years, particularly in Asia.

As the price of petroleum fuels continues to rise and alternative sources like fuelwood dwindle, governments have become increasingly interested in exploiting biogas systematically on a much larger scale. But like any other technology, successful implementation of biogas production facilities requires a thorough understanding of the social and economic environment into which it is to be introduced.

IDRC has supported four countries —Korea, Thailand, Bangladesh, and the Philippines — in carrying out social and economic evaluations of biogas technology. The recently completed studies should provide the government of these countries with useful planning information, not only on biogas, but also on the problems that the introduction of new technologies can create.

- In Korea, the research team from the Office of Rural Development found that biogas plants were mainly exploited by wealthier peasants who could afford the capital cost of equipment and installation. The energy savings they realized enabled them to recover the costs within four to five years. Climatic conditions were an important operating factor: an average of only 113 days a year in Korea are warm enough for biogas production. Researchers also found that a number of digesters were cracked or had been badly installed. As a result, the team recommended that the government install community-scale units capable of functioning year-round.
- In Thailand, a genuine enthusiasm for biogas plants was reported. This was not only because of the savings and energy independence they afforded, but because the plants helped control the spread of disease from animal wastes that had hitherto been a disposal problem. But tractors are gradually replacing draught animals in the country, and the feedstock for biogas generation is becoming scarcer. The surge in the popularity of tractors is due only in part to their versatility, the study notes. They can also be dismantled at night and brought inside the household, safe from thieves who often make off with unguarded animals. And although the benefits of biogas technology are recognized in the Thai study, some concerns were raised about cost effectiveness and durability.
- In Bangladesh, where only seven percent of the population is self-sufficient in food, farmers were found to be much more interested in increasing crop yields through fertilization than in energy. Most farmers are too poor to afford biogas generators. The researchers considered biogas technology more appropriate to providing street lighting in villages than energy in homes.
- Most biogas plants in the Philippines are in the province of Luzon. Users there, it appears, are mainly more prosperous farmers over 40 years old. The appeal to these users lay again in energy savings and the fertilizer value of the slurry. Seventy percent of all biogas plants that had been installed were still functional. The study found that cracking or improper installation were the prime reason the other plants had been abandoned. The recommendation of the Philippine study was that the government provide better training for users, and promote the technology vigorously.

Jacques Dupont

WIND OF CHANGE

Windmills. The Persians used them to grind grain in the 7th century AD. At the peak of their popularity, at the end of the 19th century, some six million were pumping water in the U.S.A. alone. And today, after decades of neglect, they are enjoying a renaissance, particularly for small-scale water pumping applications.

This technology could be of great value in the rural areas of the Third World where the cost of operating diesel-powered pumping stations has become prohibitive. But if wind-harnessing machines have come a long way in the last ten years, most new windmills — at a cost of US$4000-$8000 each —are too expensive and too complex for widespread use in developing countries. For windpower to reach its full potential, simple, robust, and inexpensive machines need to be designed.

Once such machine came to light in Ethiopia in the mid-1970s — the Filippini wind rotor. Designed by Armando Filippini, an Italian working in Ethiopia, the three-blade, vertical axis rotor was built using local materials and skills.

Preliminary trials in Ethiopia showed that, at winds averaging 18 kilometres per hour (kph), a rotor two metres high and two metres in diameter, coupled to a standard pump, could pump 400 litres of water an hour from a well 23 metres deep — enough water for 50 head of cattle. With IDRC support, the University of Waterloo (Canada) then carried out a series of tests to document the Filippini rotor's characteristics. The rotor was found to be simple to build, and harnessed 25 percent of the wind's force when blowing at 25 to 40 kph.

Using this data, research teams in Ethiopia and Botswana launched field tests of the rotor coupled with different types of water pumps. In Botswana, the Rural Industries Innovation Centre (RIIC) and Pelegano Village Industries (PVI) built four rotors of different sizes and of different materials. Tests carried out over two years showed that a locally produced Filippini windrotor could pump sufficient water for a small community at a reasonable cost.

However, wind speeds in Botswana had been underestimated at the start of the project — and during the Waterloo tests — and the researchers found that the larger rotors could not withstand the strong seasonal winds that gusted to 70 kph. Modifications needed to make the rotor and tower strong enough increased its cost significantly.

If the Filippini wind rotor proved not to be suitable to Botswana's conditions, at least the testing will have contributed to the growing body of knowledge on wind-pumping devices. And, during the course of the project, the researchers developed an apparatus for instantly measuring and recording wind speed that has attracted much international attention. The results of the Botswana study should assist the Ethiopian researchers who are continuing work on the rotor.

Moreover, says project leader Richard Carothers, the research fostered the Government of Botswana's interest in continuing the search for low-cost energy sources based on wind power and enabled local technicians to gain expertise in this field of research.

Michelle Hibler