

# Cooking in the sunshine

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'Appropriate technology' is touted as a solution to many of the energy needs of developing countries. A pilot project to introduce solar ovens in Central America shows one way forward.

"EVERY year the forest moves further and further from my house; now I have to walk three hours a day to collect what wood I can." The speaker is an Indian woman from the Pacific plain of Guatemala, where clearing for export farming has all but eliminated the forest sources of fuel-wood. Two thousand million people worldwide depend primarily on wood for cooking, and half of the annual world wood harvest of three thousand million tons is used as fuel. In developing countries, over 50 per cent of all energy is used to prepare food, which in turn consumes two-fifths of the already scarce capital. By contrast, developed countries expend less than 5 per cent of their total energy consumption on cooking<sup>1</sup>.

A solution to this unhappy situation must involve a combination of conservation and increased reliance on alternative (ideally renewable) energy technologies. Solar cooking is a natural avenue to pursue because many developing countries are equatorial and receive over 1,100 W m<sup>-2</sup> of solar radiation at normal incidence (mid-day) and up to 6,300 W m<sup>-2</sup> over the course of a day<sup>2</sup>. The history of attempts to introduce solar cooking on a large scale, however, is poor. In the 1960s and 1970s ovens that concentrated solar energy using parabolic dishes, and simple box-cookers, were tested among American Indians in Arizona, in villages in northern Mexico and in the Middle East. In our view, these projects failed to gain acceptance because they were approached as donations of technology rather than as collaborations.

Over the past three years we have been working with a variety of community groups in Guatemala, El Salvador, Honduras, Nicaragua and Costa Rica to introduce a simple box-type solar cooker (described overleaf). In Guanacaste province, Costa Rica, a group of nine women who worked together on a radio talk show concerned with women's rights worked with us to organize a demonstration of solar cooking. The Women's Solar Committee of Oriente, a village of 80 families, was formed. Each woman built an oven, and the group constructed three more ovens to be used in promoting future projects.

The protocol that has emerged from our experience, and is now used in each workshop, consists of five stages. Initial planning is completed under the leadership of a respected local person, and an oven is

given to a member of the community for a trial period. The oven's capabilities are publicly demonstrated and the theory of oven performance is discussed while a 'solar' meal is prepared. A local group, formed from the audience at the demonstration, then completes an oven workshop in which materials, tools and instruction are provided; the participants provide the labour and each receives an oven. A follow-up team is then formed to make regular house visits to monitor oven use and solve problems that may arise. Finally, the workshop group obtains legal status and financial autonomy through domestic or international grants, and further collective projects are initiated.

The local community itself carries out a screening process to select the participants, who all sign an agreement to take part in future workshops and to return their oven if it is not used regularly. That second clause has never been invoked — the women in Oriente so like the ovens that they regularly gather for solar *banquetes* where recipes and techniques are exchanged. In the summer of 1990 a second workshop was held with the Solar Committee serving as instructors for others in the community.

The final stage of the protocol encourages further box-cooker workshops as well as additional community initiatives in technology — for example the construction of high-efficiency communal wood stoves, wells, solar-powered refrigerators or larger ovens that permit shared use<sup>3,4</sup>. Projects with the potential to generate much-needed capital include high-diversity (*kandian*) garden plots; reforestation schemes; the acquisition of a community fishing boat; or rattan or latex plantations. Bolstered by the oven project, the Oriente group now plans a communal garden, which has attracted government interest and support.

During the rainy season, cloud cover may prevent a meal from completely cooking in the solar-box. Literally as insurance against a rainy day, the women of Guanacaste adopted a high-efficiency wood-burning stove, and the Solar Committee has begun making and selling these stoves with great initial success. The history of the Oriente group thus exemplifies the keys we found to high oven use: that the individuals selected make a considerable investment of their own time and energy in the project, and that they work together as a group. ▶



Spiritual approval — a parish priest in Guatemala blesses the solar ovens with holy water.

Many previous oven designs involved several collecting mirrors or telescopic focusing of sunlight to cook food by radiative heating<sup>1,2</sup>. Although ovens such as these reach higher temperatures (up to 250 °C) than the box-type model, and can in principle be operated by any member of the community, they are inconvenient to use. Focusing ovens require constant adjustment to direct the sun onto the cooking vessel, are generally unstable in wind and cannot be constructed locally. By contrast, the box-cookers can be fabricated, or if necessary repaired, with materials and carpentry techniques that are familiar worldwide. In addition, parabolic solar concentrators are not generally designed to take more than one cooking vessel. These drawbacks, and the need for the cook to stand in the hot sun over a blinding reflector, in part explain the failure of previous attempts to introduce solar cooking in developing countries.

The oven design with which we began the Central American project has undergone steady adaptation<sup>3</sup>. At each new workshop the participants suggested refinements, such as deepening the cooking space to accommodate a variety of pot sizes and adding a support table mounted on wheels. As the project progressed, the oven was tailored to fit local needs.

To study the effect of these changes, each of the seven main workshop sites was revisited and evaluated by one of us (W.F.L.) during the late summer of 1990. The ovens constructed in August 1988 at the earliest workshop in La Trinidad, Nicaragua, are almost never used (an average of 0.0 to 0.4 oven uses per week). In contrast, those constructed at the end of the project, in Guapinol and Sololá, Guatemala, however, are in constant use, from 5.2 to 6.5 days a week.

The project has come full-circle; the ovens empower the workshop participants who in turn adapt the technology, integrating it into the resource base of the community. The failure of numerous well-intentioned appropriate technology projects and, in particular previous attempts to introduce solar ovens in the developing world, can be traced to the imposition of unfamiliar technology without the social interplay and development of self-reliance.

In the oven project, we found that women are much more capable participants than the typical Latino man — their patience, dedication to precision, receptivity to learning new skills and lack of *machismo*, as well as their traditional role as family cook, all contribute to this. Women perform up to 80 per cent of the subsistence agricultural work and 90 per cent of domestic tasks in Africa<sup>4</sup>; the percentages are somewhat less skewed in Central America. It was women, both as participants and as group leaders, who proved critical to the success of the oven

### The solar box-cooker

The simple glass-topped solar box-cooker, first popularized in the 1950s<sup>2,5,7</sup>, remains the basic design today and is the prototype for our work in Central America. The glass transmits visible light, but is opaque to re-radiated infrared wavelengths: the ovens are miniature greenhouses. The pots containing the food rest directly on a conducting metal floor plate (both painted black) so the oven does not need to be constantly moved to face the sun. The ovens can reach temperatures of 150 °C in less than an hour, and can exceed 170 °C. The lid is covered in aluminium and doubles as an extra solar collecting panel. The ovens have been used to boil, bake, simmer, braize and sauté foods, and to pasteurize naturally contaminated water<sup>8</sup>; in moderate to strong sunlight a full meal can be cooked in 2–4 hours.

project. This fact should act as an impetus to multinational development agencies such as the World Bank, Inter-American Development Bank, and UN sponsored programmes (UNDP) and USAID, to emphasize educational, agricultural and business opportunities directed specifically to women. The World Bank recently launched several long-overdue educational and economic opportunity programmes for women that we hope will serve as models for other such initiatives.

But what about the economics of the oven project? On average, a poor Central American family can contribute only 25–50 per cent of the cost of the construction materials, which range from US\$80 to \$100 for each oven. This represents two to three months wages in local currency, and results from the need to use materials (glass, reflecting foil, metal sheeting and household hardware) often priced on the international market. The cost of an oven in terms of fuelwood purchases averages 6–12 months' wages, and is relatively constant throughout the region. An Indian woman from the Guatemalan highlands brought home to us the strain of the never-ending search for firewood. The woman, dressed in an intricately woven *traje*, or traditional dress, thanked us for saving her weaving. It turned out that previously most of her working day had been spent in collecting wood, but with a solar oven in the house she now had time to spend at her loom.

There are a number of technical and cultural lessons to be learned from our experiences in attempting to introduce appropriate technology in the developing world. But it is essential to keep in mind that solar ovens are only one component of a solution that must integrate such disparate aspects as basic conservation, economic empowerment of the poor, diversification of energy sources and reforestation — technology is only a tool, not a solution.

The introduction of 'appropriate tech-

nologies' on a large scale must be approached with a small-project mentality: the technology and the protocol must be tailored to local needs, with careful follow-up. As a general rule, developing nations would be better aided if large multinational agencies increased their level of support for promising small-scale projects. Helping non-governmental organizations and direct funding of proposals originating in local communities are two obvious avenues to pursue.

The beneficial effects of the solar oven project can be seen on many levels. Cooking fires, frequently located in confined indoor spaces, are consistently cited as one of the main sources of respiratory, skin and eye infections and ailments among women and children in developing countries; indeed, the prospect of smoke-free cooking was often the reason why a group requested a solar workshop. And even a modest number of solar ovens can have an important impact on the local environment. We have worked primarily with the rural poor, who are often relegated to economically marginal land. These areas, typically on the edges of swamps, deserts and rain forests, are also the most fragile ecosystems that can least support extraction of fuelwood.

At a regional level, the need for fuel leads to harvest rates that 'mine' the forests of their timber capital at unsustainable levels. The end result of this cycle can be seen in Africa, where in some countries only 10 per cent of the demand for fuelwood is satisfied. Dung is then diverted from use as fertilizer to use as fuel. The size of the problem cannot be overstated — the 400 million tons of dung burned each year in Africa and Asia represent enough fertilizer to grow 20 million tons of grain, enough to feed 100 million people for a year<sup>1</sup>.

International efforts at conservation could also be augmented by encouraging local governments to subsidize oven construction, as is the case in India. Given the enthusiastic reception that the solar ovens received in Central America, we believe that the project, properly adapted, could work anywhere. □

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