DOSSIER: ENERGY & CONSERVATION

Exploiting the desert's energy resource

Narendra Aggarwal

More solar energy reaches the Great Indian desert than many areas closer to the equator. Energy inflow from the sun into the desert is, on average, 275 watts per square metre. This is because clear skies and better atmospheric conditions over the desert permit more solar radiation to reach the land.

This unending source of energy offers a great potential for reducing the miseries that desert conditions impose on the large populations that inhabit the Indian desert.

Known as the Thar desert, this area is unique in that it is the most densely populated in the world. Covering about 28,600 sq km in the northwest of the Indian continent, it spreads over more than half of Rajasthan State. Population density varies from four persons per sq km in Jaisalmer to 157 per sq km in Jhunjhunu. Between 1901 and 1971, its population increased by 158 percent to 8.84 million. The current estimate is about 10 million.

India is blessed with abundant solar energy, estimated to have a daily value of 5.5 kilovolts per square metre. The quantum of energy received by Rajasthan State alone is more than sufficient to meet the world's annual energy demands.

Realizing the potential of this source of energy, the Central Arid Zone Research Institute (CAZRI) at Jodhpur in the Rajasthan desert is engaged in solar energy utilization research and has achieved early success, although on a modest scale.

It has started a new research project on biogas plants with the objective of maximizing gas production in the winter months and on cloudy days when the amount of solar energy reaching the plant is reduced. To begin, the glasshouse approach is being tried. The gas plant has been enclosed in thick polythene, thus keeping out desert winds and trapping solar energy for more effective gas generation.

Scientists at the Institute have another simple method for raising gas production. Water heated through a solar water heater is used to make the slurry of *gobar* (cow dung) for feeding into the plant. Thus additional solar energy is fed into the plant resulting in increased gas generation.

Recently a solar water heater *cum* solar steam cooker has been developed. Consisting of a flat plate collector, a storage tank, and a steam cooker, it can supply 100 litres of water at 60-70°C during winter afternoons, and 50-60°C the next morning. Trials have shown that it can be used for cooking or boiling cereals, rice, potatoes, lentils, vegetables, etc. Two cooking vessels can be placed side by side and 1 kg of rice or potatoes can be boiled within 90 minutes.

The main raw materials used in this system — pipes, plane sheets, aluminium angle, fiberglass insulation, glass sheets, etc. — are all easily available. It costs US$150, including material and labour.

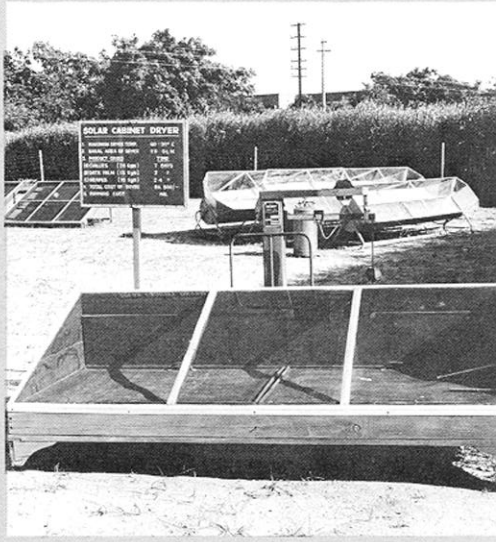
Sun drying agricultural produce to preserve it as seed, food, or animal feed is an ancient practice in most parts of the world. This is the simplest form of solar energy use. But if a little solar technology is applied, a considerable amount of spoilage can be eliminated, and fuel and electricity saved.

The solar cabinet dryer fabricated at CAZRI is essentially a solar hot box in which fruits, vegetables, or anything else can be dehydrated on a small scale. It consists of a rectangular wooden box with an insulated base area of 1.5 metre square, covered with clear glass tilted at an angle of 23 degrees. Holes are drilled in the base for fresh air to enter. The humid air escapes through outlets in the upper side of the cabinet.

Maximum air temperatures in the empty dryer vary from 55 to 95°C. Under Jodhpur conditions, 15 kg of chillies and 15 kg of dates were dehydrated, and 15 kg of grapes were converted into raisins, in two to four days. The solar cabinet costs only US$35. Permanent large solar dryers can be made from bricks, stones, or concrete.

Five different types of solar cookers were field tested at the Institute and it was found that the solar oven was best

The solar water heater and steam cooker developed at CAZRI supplies water at 70°C and can cook one kilogram of rice in 90 minutes.



Photos: N. Aggarwal

This solar cabinet dryer, one of five different types field-tested at CAZRI, is essentially a hot box in which fruits, vegetables and other produce can be dehydrated.

for the desert. It consists of a well insulated semi-cylindrical box made of aluminum and wood. The interior is painted black. The window has two transparent glass sheets. Eight reflectors made of silvered glass mirrors are also used. The oven costs US$40 and it can be manually tilted and oriented towards the sun.

On very clear days, maximum plate temperature in the oven reaches 350°C during the summer, 250°C in the winter. Practically all foods can be cooked, roasted, baked, or boiled within 25 to 75 minutes. This solar oven is highly efficient as its performance is not affected by winds and there are no chances of dust falling in the cooking pot. Moreover, the food remains warm even after sunset if kept inside the cooker.

A built-in storage type solar water heater that is cheap, efficient, and useful for both rural as well as urban areas has also been developed at the CAZRI. It consists of a rectangular tank, which holds about 90 litres of water. This tank performs the dual function of absorbing the heat and storing the heated water. It is encased in a tray, insulated at the back and sides, and covered with glass. The front face of the absorber tank is painted black to absorb the maximum solar radiation.

On winter afternoons, 90 litres of water can be heated to 50-60°C, while in summer the temperature of the water rises to 60-80°C. By using a reflector/insulator cover, the water temperature can be raised further.

Fresh water collection in arid, semi-arid, and coastal areas that are thinly populated is a time-consuming exercise as it has to be brought from far-off places. In these areas solar energy is plentiful and can be used for converting saline water into distilled water. At CAZRI, experimental solar stills have been fabricated and are being tested. Including the capital cost, depreciation cost, maintenance cost, and interest on investment, the cost of distilled water comes to only US35 cents per 100 litres. □

Narenda Aggarwal is staff correspondent for the Hindustan Times, *New Delhi, India.*

Crop drying:

something new under the sun

Solar drying of crops is an age-old method of food preservation practiced around the world. But the traditional method of spreading the crops on the ground, while inexpensive and relatively effective, often results in significant losses. During the rainy season, it also results in a product with a high moisture content that spoils quickly.

In recent years, attempts have been made to increase the effectiveness of traditional sun drying techniques in order to make better use of sun and wind, obtain a higher quality produce, and reduce contamination by dust and insects and the dangers of incomplete drying.

The postproduction group of IDRC's Agriculture, Food and Nutrition Sciences Division is encouraging several novel approaches to crop drying using sun and wind as the principal sources of energy. Here are some examples:

• Cassava is a staple food crop in many Southeast Asian countries and, in the form of starch, pellets, and chips, is an important export commodity. Processing generally involves chopping the roots by hand or by machine, then spreading the pieces to dry on a concrete floor.

As part of an IDRC-supported project on cassava processing, experiments were carried out in Thailand on different sun drying techniques. It was found that thin slices or strips dried more quickly than chips. The drying time was considerably reduced when the cassava was spread on a black topped floor. Drying trays suspended above ground were also found to be effective because they permitted greater air circulation.

• The cultivated area of Egypt is only about four percent of the total land area. This area lies along the Nile river whereas the consumers of the products are scattered throughout the country, thus necessitating extensive transportation.

As Egypt enjoys intensive sunshine — 3600 hours a year on average — solar drying is widely practiced. The present method of spreading the produce on the ground, however, results in significant losses.

Late in 1977 the National Research Council of Egypt began work on developing methods for utilizing the available solar energy, at different latitudes, for drying agricultural produce and fish. After evaluating the drying requirements for the commodities (grapes, apricots, and fish) and recording the solar and atmospheric variables at Cairo and Fayoum, an agricultural community surrounding an oasis 100 km southwest of Cairo, three different designs of solar air heaters will be developed, each based on the solar flat plate principle but adapted to the specific needs of the commodities.

The dryers will be tested and compared to traditional methods. Other traditional sources of energy will be used to some extent in combination with the solar heater to develop the most economically advantageous dehydration unit.

• The introduction of new high-yielding rice varieties has made multiple cropping possible in Thailand and other Asian countries. Much of the benefit of this second crop is lost, however, as the farmer cannot dry it properly during the wet season and is forced to sell it quickly, at a low price, before it spoils.

The Asian Institute of Technology (AIT) in Bangkok has therefore designed a prototype solar rice dryer. Built on a mound of earth, it consists of a one square metre flat bed box made of wood and plywood, covered by a plastic sheet. A mosquito net serves as the floor. The air heater consists of a layer of burnt rice husks to absorb solar radiation, covered with clear plastic on a wooden framework to form an air duct. The entrance faces south, into the prevailing winds during the wet season.

The system functions by natural convection and heats the air passing over the solar collecting surface to 40-45°C. Tests have shown that in one to two days of sunny weather, 10 cm of wet paddy grains were dried to 14 percent moisture content — the level required for safe storage. In three to four days of cloudy weather, up to 20 cm of paddy was dried.

An IDRC grant will now enable AIT researchers to build and test a dryer suitable for a small farm and experiment with different materials and methods of construction.

• While carrying out a large-scale program of sorghum breeding, intercropping and preservation, researchers at the Centre national de recherches agronomiques (CNRA) in Bambey, Senegal, found that storage losses resulted largely from the poor quality of the grain stocked in the silos. The crops were generally sun dried in stacks in the fields where they suffered insect damage. The moisture content was also high.

The research team determined the angle of the sun for every day of the year and the direction of the prevailing winds. During trials it was found that the wind had a greater effect on crop drying than did the sun. They therefore built simple platforms, using local materials, and oriented them so that the heads of the unthreshed grain face into the wind. What they produced was simple solar cross-flow dryer that significantly reduces grain moisture.