Solar cookers in developing countries

Ferdinand Kroon, 2004

In the 70ties deforestation in developing countries was mainly attributed to the use of firewood in domestic energy supply. In many developing countries the majority of the population cooks on firewood. In response, many (Western) organisations developed new technology like improved versions of traditional cook stoves, biogas plants and solar cookers. While in urban areas the commercial market for wood and charcoal is directly linked to deforestation in these regions, household firewood use is no longer seen as a major cause for deforestation in rural areas. This, and the failure of many solar cooking projects have resulted in reduction of subsidies by local governments (like India who has the largest number of solar cookers), international donors and NGO's. However, many (small) Western NGO's are still very dedicated to the goal of introducing solar cookers in developing countries.

Solar cookers use sunlight as an energy source to cook food. No other energy source is needed for a solar cooker to operate. If the traditional energy source is firewood, the time or money needed to collect the wood is saved. Also, cooking on wood creates indoor air pollution (smoke) which can cause disease. Solar cookers can also be used for other purposes, for example to pasteurise water. Several NGO's supply a simple water pasteurisation indicator along with the solar cooker. Different designs of solar cookers have specific advantages, as will be explained in the next section.

Solar cooker designs

There are hundreds of different designs of solar cookers. Most types of solar cookers were designed by Western organisations. Basically, they can be divided in four types; box types, panel types, parabolic types and indirect types. The construction costs of solar cooker vary widely, independent of the type. For every type a black metal pan should be used. Black makes sure the incoming sunlight is absorbed and metal conducts the heat to the food inside the pan. The traditional pans are often not compatible with the solar cooker. In these situations, pans need to be distributed with the solar cooker as well.

Box cookers

Box cookers are insulated boxes that capture the energy that shines into it. The glass top creates a kind of greenhouse effect in the box. One or more mirrors are attached to the sides of the box to allow more sunlight to enter through the glass top. Depending on the design and the temperature of the surrounding air, temperatures of over 100 °C can be reached. Box cookers exploit both direct and diffuse solar radiation. Therefore, they do not need to be positioned facing the sun frequently.

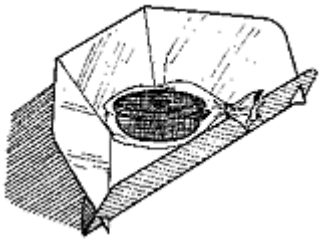
The box type solar cooker doesn't reach very high temperatures (no frying or roasting is possible) and should remain closed during cooking, which makes stirring or adding of ingredients impossible. Therefore, the solar box cooker can be used to prepare for example rice or lentils over a time period of a few hours during the day when the user is out at work. When the user returns the food will be ready.

A box cooker.

Panel type cookers

Panel type solar cookers consist of a number of reflecting panels. The focus of the panels is the pan. To prevent the pan from losing its heat, the pan is put in a transparent and heat resistant plastic bag. The heat will be lost when the bag is opened. As the box cooker, this prevents any intervention in the cooking process for stirring or adding of ingredients. Temperatures of just over 100 °C can be reached. These bags have a limited lifetime. In some projects, the demand for the plastic bags has been used as indicator for prolonged use of the cookers. However, often this demand is disappointingly low.

A currently popular design is the CookIt. The CookIt is made of cardbox, with a layer of aluminium foil glued onto it. The cardbox is cut is such a shape that it is in one piece and can be folded to a small package. Though CookIts are basically very simple, it seems difficult to find local producers. The construction cost for a CookIt are only a few euros.



CookIt, a panel type solar cooker.

A parabolic solar cooker.

Parabolic or concentrating cookers

This type of solar cooker concentrates the sun's rays to a focal area where the pan is located. High temperatures, well over 150 °C, can be reached when the cooker is well positioned at the sun. The cooker needs to be repositioned at the sun frequently, at least every 15 minutes. However, in contrast with the solar cooking box, cooking times can be similar to traditional stoves. Disadvantages are that the food in the pan may become too bright and in some designs burning injuries may occur.

Collector or indirect cookers

Collector cookers consist of two parts. A collector and a cooking range. The collector can be placed outdoors, while the cooking range can be located in the kitchen. These cookers make use of diffuse and direct solar radiation. They are, however, rather complicated to build. The collector cooker can use air or steam for the heat collection, but also a liquid like oil can be used. In that case, the heat can be stored for a short period of time. This period is often not long enough to be able to cook in the evening. Temperatures of up to 150 °C can be reached when a liquid like oil is used. These types of cookers are typically expensive compared to the other types.

A collector cooker. Mirrors are added to increase the amount of sunlight falling on the collector.

Usage of solar cookers

Traditional cooking customs differ significantly with cooking with a solar cooker. This section discusses some uses and requirements.

A solar cooker can only be used when the sun shines, i.e. in daylight hours. Even then, cooking time can vary according to the weather conditions. As any type of solar cooker is dependent on the amount of sunshine, a solar cooker cannot replace the traditional energy source completely. In practice, the solar cooker is used to prepare a certain type of food, for example to cook the rice while the traditional stove is used to prepare the meat.

The solar cooker requires a location in the sun. This can be in the courtyard or on the roof for example. Especially in urban areas, users may not have access to a sunny location. Also, the solar cooker needs to be positioned where it is able to withstand the weather conditions, panel and parabolic solar cooker types are typically vulnerable for strong wind. The solar cooker usually can not be left unattended outside, the cooker may be damaged by children or livestock. (Goats are especially notorious solar cooker haters). Users have to be prepared to take out the solar cooker every day and cook in an open/public area.

Especially parabolic and box type cookers are generally too heavy to carry in and out each time. The portable nature of the solar cooker also means that other people can take it somewhere else too (theft).
Even when the idle solar cooker can be left unattended, a box or panel type cooker requires long cooking times in the sun. The contents of the solar cooker could be eaten by children, livestock or other animals. A solution for this problem in a project in South Africa was to place the solar cooker on a table, however now the table had to be moved outside as well causing additional discomfort for the users.

Cooking times for a parabolic type cooker are about as fast as conventional stoves, but these cookers need constant attention. It has to be positioned at the sun frequently. This does also mean that the cook has to be at home in the afternoon to prepare the evening meal. In practice, often a haybox is used to store the food after preparation. The food can than be used in the evening.

An open fire generally has more uses than preparing the evening meal. The fire can be used to heat the house or the smoking out of insects. Many projects dealing with cooking on different energy sources have also shown that some people prefer food cooked on an open fire than on other energy sources. If food is prepared in a solar cooker the taste, texture, and colour of the food varies from food prepared with traditional cooking methods.

Solar cookers can also be used for other purposes than cooking food. The high temperatures that can be reached in the parabolic cookers allow distillation of water for batteries. Solar cookers can also be used to pasteurise or sterilise water. Several NGO's distribute the CookIt with a simple water pasteurisation indicator.

Distribution of solar cookers

Almost all solar cookers are distributed via NGO's, who partly or fully subsidise the solar cookers. The costs of awareness raising, promotion and training to use are not included in the price of the solar cooker. In some cases, even the distribution and material costs are not included. The distribution remains dependent on subsidies of the NGO. The international NGO's distribute the solar cookers via local NGO's or via existing shops. The channel of distribution via local NGO's is something which people are not used to and also means that maintenance and repair service can not always be assured. The NGO typically offers a limited number of solar cooker types.

It is often difficult to produce solar cookers locally. Materials like glass, mirrors, or reflective-coated aluminium is not easily available. Even for simple solar cookers like the CookIt it turns out to be a problem to find local producers. In practice, a (Western) NGO imports (parts of) the solar cookers. The solar cookers are than sold for a subsidised price locally. Although there are many small NGO's of dedicated people, their reach remains limited in number of potential beneficiaries.

Experiences from solar cooker projects

Many early programmes with solar cookers failed, which resulted in a polarisation of the opinions on solar cookers. Some people regard it as an inappropriate technology, while others are still confident in the success of solar cooking. Projects have failed for example because the solar cooker is not able to prepare food for large families, because cooking and eating times are too different or because cooking times are considered too slow.

Despite the subsidised price for a solar cooker, users often still regard the solar cooker as expensive. In many cases, wood fuel is free and therefore there's no economic advantage. Generally, cooking has low priority compared to other household expenditures. Users will buy a TV sooner than a solar cooker. If the user does want to buy a solar cooker, a credit is needed for the purchase. This credit is rarely available.

In a project in South Africa, the solar cookers were seen as a piece of technology by the local community. Men perceived the solar cooker as a special engineered barbecue and were willing to prepare food on the solar cooker. However, this was only the case when a female audience was present. The men applauded the new technology, because it allowed the women to do more other things. The time saved on wood collection could be put to other uses, relieving the men of some of their duties. After a few months, the solar cookers were disused, by both men and women. The solar cookers were seen as flimsy and temporarily.

In some cases, the additional nature of a solar cooker may be an advantage. It can be a gadget to prepare only rice for example. Like pressure cookers, or special rice cookers are gadgets. This may appeal to some kinds of user. Not many projects have accentuated the additional nature of the solar cooker. However, in many projects the solar cookers were not used to prepare food, but rather only for the preparation of hot drinks like tea. In some minor projects in West Africa, parabolic type cookers were not used for cooking, but for distillation of water for batteries and sterilisation of medical equipment.

Solar cookers and the greenhouse effect

It is sometimes said that the use of solar cookers saves carbon dioxide emissions, which cause the greenhouse effect. However, this is not always the case. Cooking on firewood is CO_2-neutral, meaning the CO_2 emissions do not contribute to the greenhouse effect, given the firewood is collected in a sustainable manner. Only in case the solar cooker saves the use of fossil fuels (or unsustainably collected firewood) there is a saving in CO_2 emissions. It is difficult to determine whether firewood was collected sustainably or not.

Conclusion

Many projects in the past have failed, or were only partially successful. However, the difficulties with suitability of solar cookers to local cooking needs are not impossible to overcome. The users and local cooking needs need special attention in any solar cooking project. Though this is a time-consuming process, it can be considered a requirement for success. Marketing and dissemination are important issues, traditional cooking customs are very resistant to change, people will cook on firewood until absolutely no wood is available any more. Also, it is important to recognise that solar cookers are a complementary technology and not a substitute for the traditional household’s cooking fuel.

Recommendations for further reading

http://www.wot.utwente.nl/
http://www.areed.org/training/technology/solar_cooking/
http://www.gtz.de/
http://www.eg-solar.de/
http://www.solarcooking.org/
http://www.kozon.org/