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Series 5: Programme 1 (of 9) - 'Energetic'

Rise and Shine – Mali

In a country like Mali, where the sun shines intensely almost every day, few rural people have access to electricity, and firewood supplies are scarce and depleted, it makes practical as well as environmental sense to use solar energy as much as possible. One enterprise is using the flat roof of its office for solar drying of fruit, vegetables and meat, as a method of preserving food that would otherwise spoil in the hot climate.

Few people in Mali have refrigerators to keep food fresh longer. Controlled drying is a suitable way of preserving fresh food that cannot be sold within a reasonable time.

USISS (*Usine Semi-Industrielle Sechoire Solaire* - semi-industrial solar drying enterprise) is a company that has been drying meat, onions and mango since 1990. It buys the surplus during harvest times and supplies the dried products outside the harvest periods when the demand is greatest. USISS has been working with the Mali-Folkecenter, an NGO that is the Malian country enterprise development partner for the AREED (African Rural Energy Enterprise Development) programme to develop its dried food enterprise.

Enterprise Development

USISS was set up from a pilot project by GTZ, a German government donor agency, to test the viability of solar food drying with tunnel driers. The viability was proved and when the project finished the manager of the project was able to buy the driers for a low price and set up USISS as a commercial enterprise.

Farmers and suppliers take mangoes, onions and meat to USISS in Bamako and USISS pays them for the produce and then dries and packages it. The products are sold to shopkeepers, market stallholders or roadside traders. Typically income for USISS exceeds expenditure by 25 per cent on meat, 600 per cent on mango and 120 per cent on onion.

The products are always in demand, except for mango during the harvest season between April and July, and onion between September and December and the company's products sell out quite often. The products are packed in 50 g bags.

Potential for Expansion

During most harvests USISS has been able to choose its suppliers of mango and onion. Some years the company can only use a small proportion of the mangoes and onions that the farmers could supply, and a lot of the surplus still goes to waste.

USISS recognised that there was a clear opportunity for business expansion and have worked with the Mali Folkecenter on producing a proposal and business plan. As a result a loan of approximately US\$18,000 was approved by AREED. With this loan USISS proposes to install two additional solar tunnel driers and provide the company with sufficient working capital to expand production threefold.

The Solar Tunnel Drier

The drying technology that USISS uses is relatively straightforward. The driers cover a four metre width as a pair, each one two metres across and 20 metres long. They are situated on the flat roof of the USISS building. The driers are plastic tunnels with a transparent sheet on top and a black sheet, which absorbs solar radiation, underneath. The drier consists of two sections. Air is warmed up in the first and the food for drying is placed in the second. Fans, attached to the first section, blow air through the driers. The air is heated by the sun as it passes through. The materials to be dried are put on trays that are then placed on the bottom sheet and covered with the upper sheet.



*Meat on trays ready for drying, USISS, Bamako, Mali
Photo - Lundgren*

Note that as in the second section the trays cover the black heat absorbing material the direct heating effect from the sun is less than in the first section.

For the two new pairs of driers that USISS intends to install it has been found that the materials can be sourced locally. These materials are being evaluated against imported materials to find out which would be less costly over a long time. While USISS have been operating the same drier since 1990 the plastic sheeting has needed to be replaced on a regular basis. Plastic that is more expensive but is more durable could well turn out to be cheaper over the lifetime of the drier.

Although modern tunnel driers now use solar photovoltaic power to drive the fan, USISS is using electricity from the grid. However, this is generated by hydroelectric power so can be considered renewable.

Drying of Fruit, Vegetables and Meat

The safe drying of food is a complex process and it is not possible to provide full details here. More specialised information sources, such as those listed at the end of the case study, should be consulted.

The exact drying conditions required are affected by the size of the source material and its initial moisture content as well as the temperature that is reached in the drier. Note that with a relatively simple drier such as that used by USISS the temperature in the drier will vary depending on solar intensity, ambient temperature, and speed and direction of wind. It takes considerable experience to adjust the drying times based on the external weather conditions.

Most fruit and vegetables have natural moisture contents of 75 to 90 per cent. In drying for preservation the aim is to reduce this to around 5 per cent, and even less for meat. For air drying at temperatures between 55 and 65°C, at which most driers are aimed to operate, drying times would be 12 to 15 hours for onion and mango and about 12 hours for meat.

To increase the life of dried food, preservative treatment is recommended. The most common for fresh produce is sulphur dioxide (E220), obtained by soaking the material in a solution of sodium sulphite, sodium bisulphite or sodium metabisulphite for a few minutes before drying. There are some health concerns about E220 and alternatives include dipping the materials in common salt solution or blanching (lightly boiling for a short time) before drying. Note that even with preservative treatment and drying mango will still spoil in one or two months, so it is more commonly made into jams, jellies, purées and leathers (purées that are dried to a consistency similar to leather). Dried meat and onion will keep for longer.

Ideally the dried product should be conditioned in a dark area at room temperature for a few days before packaging.

Wider Impacts

USISS has five permanent employees and this is expected to increase to 15 when the additional driers have been installed. However, the project is expected to have a much wider impact as USISS would be able to buy more of the source materials from farmers and suppliers, who in turn would have higher incomes and less of their harvest would be wasted. More people would also be able to have an income trading in the dried products.

It is likely that the demand for dried food in Mali is still far from being met and there is potential for other producers to set up in business as well. USISS would be a model for these potential businesses and an example of committed use of renewable energy.

Further Information

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The tunnel driers used by USISS are likely to be based on a design originally developed by Hohenheim University in Germany and now marketed by the above company. These driers are used in 55 countries throughout the world and the fan to drive hot air through the tunnel is now usually driven by a solar photovoltaic unit. An assessment of this drier has been published in ITDG's Food Chain Newsletter, No. 31, November 2002, pp. 20 - 22,

http://www.itdg.org/docs/agroprocessing/food_chain_31.pdf

Books available from ITDG Publishing

- *Drying*, UNIFEM Food Cycle Technology Source Book, 1995
- *Drying Food for Profit - A Guide for Small Businesses*, Barrie Axtell & Andrew Russell, 2002
- *Setting up a Food Drying Business*, Fabrice Thuillier, 2002
- *Try Drying It! Case studies in the dissemination of tray-drying technology*, Barrie Axtell & Alex Bush, 1991

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1. Drying of Foods, http://www.itdg.org/html/technical_enquiries/docs/drying_of_foods.pdf
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3. Tray Driers, http://www.itdg.org/html/technical_enquiries/docs/tray_driers.pdf
4. Drying of Apricots, http://www.itdg.org/html/technical_enquiries/docs/drying_of_apricots.pdf

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http://www.itdg.org/html/technical_enquiries/tes.htm

GATE Question & Answer Service

Documents available on solar drying equipment for food:

Solar Drying in Morocco, M. Häuser & O. Ankila, 1997,

<http://www5.gtz.de/gate/id/Download.afp?PubName=../publications/G58SOe.pdf>

Solar Drier Plans: PGCP Coconut Drier and Kenya Black Box Drier, Matthew G. Green, Dishna Schwarz, 2001,

http://www5.gtz.de/gate/id/Download.afp?PubName=../techinfo/techbriefs/E16e_2001.pdf

Solar Drying Equipment: Notes on Three Driers, Matthew G. Green, Dishna Schwarz, 2001,

http://www5.gtz.de/gate/id/Download.afp?PubName=../techinfo/techbriefs/E015E_2002.pdf

Solar Drying Technology for Food Preservation, Matthew G. Green, Dishna Schwarz, 2001,

http://www5.gtz.de/gate/id/Download.afp?PubName=../techinfo/techbriefs/E014E_2002.pdf

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