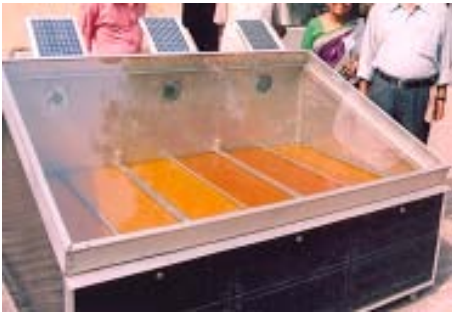




CASE STUDY - India

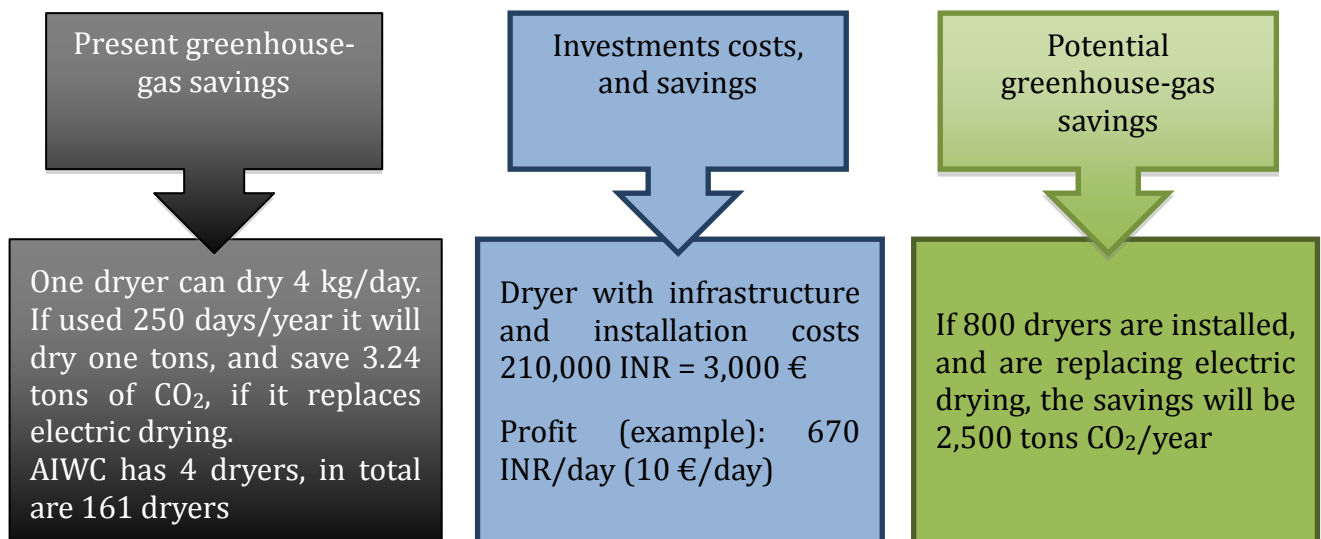
Solar Dryers for Income Generation

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Summary

Solar dryers were tested in four places in India. The activities were carried out by the All India Women's Conference (AIWC), a non-profit NGO, which has 150,000 members in 500+ branches. The solar dryers can dry fruit and vegetables in sufficient quantities to create livelihood for one person. The dried fruit and vegetables are of good quality and can replace fruit and vegetables dried with electricity or gas.



Introduction

All India Women's Conference (AIWC) is one of the oldest and pioneering Women's not for profit organization. AIWC was established in 1927 in India by an Irish Lady, Margaret Cousins, for the education & emancipation of women, along with eminent Indian women like Sarojini Naidu, Rajkumari Amrit Kaur, and others. It has more than 150,000 members and 500-plus branches across the country working for the empowerment of women. Amongst many projects AIWC has undertaken one of the important programs is implementing application of renewable energy technologies with the objective of making them a tool of women's self-reliance, through various low-carbon technologies for over four decades.

India is the only country which has a separate Ministry of New and Renewable Energy, Govt. (MNRE) at the centre for promotion of renewable-energy technology. AIWC has collaborated with the Ministry for the successful implementation of the projects, being identified as one of the Nodal Agencies.

Drying of Fruits and Vegetables

Drying of fruits and vegetables is a well-known practice in India. Sun drying is widely practiced. But, hardly 2% of the country's horticultural produce, i.e., fruits and vegetables, are processed. Countries like Thailand, Philippines, USA, process more than 70% of their produce.

Solar Drying Technology

Solar dryer technology can be utilized in small-scale food processing industries for producing hygienic, high-quality food products. It will also promote renewable energy sources as income-generating units, apart from saving the world from the ill effects of climate change. Thus, with a vision to enhance incomes of women from economically poor strata in rural India, to promote a renewable energy source, and to produce a quality value-added food product, AIWC came out with the project "Income generation for poor women through solar dryers in Andhra Pradesh, Kerala, Tamil Nadu and Delhi". The one-year-long pilot project was conducted successfully in four places: Delhi, Trivandrum, Chennai and Hyderabad. After a lot of consultations, a SDM-50 type solar dryer was selected, and the pilot project was implemented with the installation of four solar dryers at Chennai, Hyderabad, Trivandrum and Delhi.

Socio-Economic impact:

Creates livelihood for one person for each dryer.

Environment impacts:

If solar drying replaces drying by electricity or fossil fuel, it reduces CO₂ emissions.

The project was implemented through AIWC Head quarters, New Delhi, Women's Indian Association, Chennai, Priyadarshini Mahila Samajam, Trivandrum and AI.

Usually a minimum of 4 solar dryers will be chosen for one economic unit, but in our case, we tried out the project in four different regions with funding from Asian Development Bank Small grants programme, in 1984-85. Although there are many cheaper models, we had selected the SDM-50 solar dryer, developed by the NGO "Society for Energy, Environment & Development" (SEED) from Hyderabad after 10 years of intensive research under the leadership of Prof. Ramakrishnan Rao, who is still helping us with the project whenever needed.

In Puducherry, where the project of solar drying is being launched as a follow-up, there are many "Self Help Groups" (SHG), who are supplying mid-day balanced meals (Poushtik Ahaar) under the ICDS Program. Further, all the solar-dried projects, including "Aam Papad" (mango bars), are being marketed by the Renewable Energy Agency of Puducherry. Hence, with mitigation of global warming, we believe that this project will prove to be successful in Puducherry and can contribute locally and globally to post-2015 Millennium Development goals.

Objectives of the Project

- The solar energy application as a value addition device for the fruit- and vegetable-processing industry at a micro level, especially fruit bars/rolls.
- Assurance that SHG members (mostly women) can operate this modern equipment with zero energy cost & maintain the equipment themselves with minimum help.
- Saving enormous quantity of fruits and vegetables which perish all over the rural areas due to lack of preserving, processing & marketing facilities.
- Helping all the Asian countries who are already preserving their produce into value-added & hygienic products.

The one-year long pilot project was carried out in two phases:

1. Training and installation of dryers in four locations. More than one hundred women have received intensive training in all the aspects of solar drying, and another two hundred women, including members of SHGs, have been given full orientation and short training.
2. To carry out production on experimental basis.

Experiments were done with different products in different locations based on available resources and demands along with the validation of technology. Mango bars, Ginger powder, Margosa powder and Fenugreek powder for diabetic patients and desiccated coconut powder were few of the products. Details of each product were systematically filled in a cost analysis. One of the key outputs of the project is a matrix that gives details of profitability, and marketability of various solar dried products across seasons.

SDM-50 Solar Dryer for Food Processing and Dehydration - A brief note on the technology

Solar dryers (SDM-50 Model)

- The construction of the solar dryer involves a metal cabinet made of aluminum alloy with a glass window on top. The stainless-steel trays are provided in the cabinet to hold the material to be dried in the solar cabinet dryer.
- Thermostat control sets temperature in mixed solar and electrical mode.
- Closed trays are provided for easy loading and unloading of product.
- Solar photovoltaic (PV) fan circulates air in the cabinet.
- A special glass filter is provided to block Ultra Violet (UV) radiation and to reduce the solar intensity for special applications.
- The product is clean and hygienically prepared, meeting cleanliness specifications of ASTA of USA.
- The temperature achieved in the cabinet is in the range of 40-65°C on clear sunny days.
- The temperature difference between the ambient and inside cabinet is 15-30°C on sunny days.
- The dryer is rain-proof, dust-proof, rodent-proof and insect-proof due to fixation of an EPDM gasket, which can be replaced easily as needed.
- The moisture control in the product can be achieved by the regulation of drying time based on the intensity of solar radiation.
- The critical size of the micro-enterprise is 4 solar dryers (SDM 50 Model) with a minimum capacity of 4,000 kg (4 tons) per annum of fruit bars/rolls.
- It is modular and scales well to any amount of demand.



Advantages of the Technology

We can dry, prepare and preserve the following food items:

- Many kinds of cereals like wheat, barley, etc. and their associated products- flour, maida, rice wafers, tapioca wafers, sevia, noodles, legmes; (green leaves like kasturi methi, pudina, drumstick leaves); root vegetables – potatoes, etc., other vegetables; fruits and their pulp; sweets, Mango bars; kadi masala powder/kadi leaf powder, ginger powder, masala & condiments, black pepper, dry tomato slices/powder, dry basil leafs, dry drumstick leaves, cured green chillies, cured bitter gourd, herbal plants, papad, forest products; fish, meat; coconut and many other products could be processed in less time. Though this dryer is expensive (about 11/2 lakhs), if 4 dryers are bought and run by SHG's, there is big scope for earning very good income through supplying to local and foreign markets.
- Most of all, when we are talking of food security, we could not only save tones of produce going to waste but provide good income for the women. In addition we could distribute nutritious food to our children and mothers. We could also help in mitigating global warming through the use low-carbon technologies.
- If the food-processing technology is introduced at the micro-level, it will help to preserve perishable food products as well as create opportunities for increased rural employment. SHG members will be able to operate with zero energy cost and maintain the equipment themselves with minimal difficulty.

Estimated Budget (Model Budget)

For an economically viable project for 4 tonnes (approx.) annual production capacity of fruit bars at solar food processing centre:

ITEM NO.	EXPENDITURE INCURRED	COST IN RUPEES
1.	Capital Investment, Equipment & Machinery Cost- Four (4) solar dryers – SDM-50 Model Ex – works price @ 1,25 ,000/- * 4 nos. and packing , transportation , Installation at site and insurance costing Rs. 1, 00,000/-	600,000
2.	Processing & Packing Equipment, Utensils Kitchen including gas stove and cylinder, Food Processor, Hot sealing machine, Price labeling machine, Hot air gun (for shrink pack), Other items	50,000
3.	Infrastructure, Construction of platform for 4- solar dryers (including labor & materials) , Office , processing & stores This is optional where basic infrastructure is not available.	150,000
4.	Installation Supervision & Organizing (15 days intensive training)	50,000
5.	Trainers Training, One time training to trainers at Pondicherry for processing of mango bars for 16 persons for 3 days excluding travelling & accommodation.	30,000
6.	Follow-up Inspection by Central Office (including travel & accommodation), Project Director, Secretary.	120,000
7.	Evaluation & Report	100,000
8.	Honorarium for supervision 2 ,000/- month for 1 yr (by members & staff of the local Branch)	24,000
9.	Administrative cost,	117,800
	Miscellaneous	60,000
	GRAND TOTAL	1,301,800
	Grand Total in USD (Exchange Rate 1USD = INR 61.285)	\$21,241.739

Product Preparation and Marketing

The products were identified on the basis of season, fruits and vegetables available in the local market and market survey.

The branch in Tamil Nadu experimented with tomato powder, curry leaf powder, kasuri methi and bitter gourd powder. Delhi pilot dried tomato slices, kasuri methi, mango bars, kadi masala powder, tomato powder, amla powder and ginger powder. The members at Delhi dried basil, pudina and drumstick leaves apart from mango bars. Simple dry kadi leaves having medicinal values were also produced. The kadi leaves dissolved in water provide cure for BP problem in human beings. Kerala branch performed very well and experimented with curd green chilies, curd bitter gourd, black pepper, rice wafers and tapioca wafers. With their own efforts they have purchased one more dryer for their branch.

The details of each product were recorded systematically in a cost analysis report prepared specially for the project.

Marketing Details: The prepared products were sold at the calculated prices based on the production and depreciation cost. A percentage of packed products were supplied as samples to retailers and canteens for testing. All of the solar dryer units have been promoting marketing through known linkages. At Delhi, packs of tomato slices were distributed as samples to specialty outlets and restaurants. Other products were sold through the AIWC counter at the main branch. Mango bars, methi leaves and ginger powders sold extremely well.

The market study at Chennai and related experiences reveal that mango bar toffee can be marketed through school canteens and can fetch a good profit. At Chennai, marketing was done through school canteens, Red Cross Society, other NGOs, and local contacts. The Kerala unit tried to market the products through linkage and local sources. At each of these places, only one solar dryer was used, which helped us with the cost analysis.

Findings

All four pilots tried to prepare dried food products out of raw materials available locally. Some products managed to earn profit and a few incurred losses. The reasons for profit and loss varied among products. In this chapter, we analyzed the causes for profit and losses incurred by different products.

All of the products were selected carefully for availability of raw materials, but because of differences in marketing forecasts and actual consumers' preferences, few products faced loss. This section is an attempt to analyze performance of each product separately.

Composition of mango fruit mix for one layer. Usually, 3 layers are laid for one 100-gram packet of mango bar.

Financial impact of one load of mango bars:

Raw material weight	38 kg (mango pulp, sugar, pectin, citric acid, etc.)	
Cost of raw material &	1,200/-	\$ 18.84
Other expenses per load		
Mango bar Yield /Output	17 kg	
Sale price per Kg	Rs 110/-	\$ 01.72
Sale price per 17 Kg	Rs 1870/-	\$ 29.36
Net Profit Per Load 17Kg	Rs 670//-	\$10.52
No. of Batches Per Annum	70	
Net Profit Per Annum	Rs. 46,900/-	\$ 744.44

(according to 2004 AIWC - ADB Project)

The Chennai branch produced 122 kg of mango bars and was able to sell 90 kg. The Women's Indian Association is making 100 g, 25 g, and 10 g bars, which is marketed through Red Cross Society and school canteens. The Delhi Pilot project produced 33 kg and sold 32 kg. Market survey reveals that small packets of mango bars of 20 g might be sold through canteens at Chennai and Delhi. Thus the hygienically prepared mango bars are available for the school children (all of these are from pilot projects).

All together, mango bars gained a profit of 70%. The Tamil Nadu pilot procured 91% profit, as the branch sold small packets of Rs 5. These small packs provide a greater profit margin. The Delhi unit made 100 g packs and sold at Rs 15 per pack.

During interaction sessions with the members of SHG groups, including those who had taken the training of producing mango bars, we found the members willing to produce and sell small packs of mango bars to the school children of small towns whose pocket money is only Rs 1.00 per day.

Products	Tamilnadu#	Delhi#	Kerela*
Tomato powder	25	-47	
Curry leaf powder	-43		
Kasuri methi	-467	35	
Mango bar	91	15	
Bitter gourd powder	-33		
Bitter gourd chips	-55		
Ginger powder		-1	
Kadi masal powder		23	
Curd green chillies			35
Curd bitter gourd			9
Black pepper			10
Rice wafers			20
Tapioca wafers			20

* It is assumed that all the quantity prepared is sold.

Based on actual production and sales record

The matrix shows that the profit percentages for the different products in three pilots. The same product is appreciated in one place but faces huge losses in a different state because of the variation of the food habits, cost of raw materials, etc. Thus, selection of products to be prepared in the solar dryer units must be made very carefully, based on the availability of the raw materials in local markets, consumer's preferences, and food habits.

Learning

This two-year research project brought out both technical and non-technical problems which created the base for upgrading the program and the solar dryer for further extension.

Some of the technical problems are listed below:

- Chennai unit faced the problem of insect penetration. The reason was found to be a crack in a rubber tube.
- Thermocol packing used for fixing thermometer got damaged in Delhi unit, which increases the risk of mixing of the small pieces with the material being dried as well as risk of breakage of thermometer.
- Fans used were not of good quality. Now AIWC Hyderabad branch has managed to change them.

Non-technical problems included those which were faced during production and marketing:

- record keeping was very difficult in the units where the users were mostly semi-literate, belonging to economically poor section of society.

All of these problems were set right by SEED.

The local advocacy role in the project:

- Whenever enough awareness was given to women and the general public of the benefits of using the solar dried products, great demand was created.
- At the level of disadvantaged strata of the society (the poor), the income generation aspect of the solar dryer project was appreciated and there was a great demand for further programmes.
- At the governmental level, the efforts taken by AIWC and partners to inform the officials at all levels, including Ministers, lead the Government of India to announce a substantial subsidy of 50% in the price of the SDM-50, which has been approved by Ministry of New and Renewable Energy, and the subsidy is still in operation. This has helped many self-help groups, and NGOs apart from AIWC branches, to procure this solar dryer and start income generation programmes for rural women and other interested persons. But this help has not been used as much as expected, since the request for subsidy has to be routed through the State Government Departments, who do not give priority to this programme. This, despite to great importance for stopping the big wastage of rural produce, giving decent income to women and men, saving of energy, and mitigation of global warming.
- The fast-food joints are more than ready to buy the tomato powder, ginger powder, and tomato slices dried in solar dryers, once they come to know that they are available, since they realize the value of these solar-dried products.
- The Hyderabad branch, which is continuously running the project successfully even now, is trying new products all the time, like pasta. Recently, with the help of SEED, they have brought additional technology, of fixing dehumidifiers in the cabinet along with the fan to prevent the moisture from going to the top layer, where it might grow fungus. This helps a lot in drying of fish.
- The AIWC Hyderabad is also in the process of preparing “Ragi Malt “for mid-day meal (for school children) at Tholikatta village in collaboration with the SEED and funding from the Government of India. They prepared nutritious drinks also for school children and have got an all-India market.

Solar drying is continued in four states and recently AIWC has conducted a Solar Training Programme in collaboration with SEED at AIWC's headquarters.

It is estimated that one ton of fruit processing eliminates about 3,240 kg of CO₂ emission. Currently there are about 161 solar dryers operational in India that produce about 165 tons of fruit bars. This results in reduction by 500 Mt of CO₂. Use of solar energy will reduce the requirement of electricity to up to 1,188,000 kWh in a year, which corresponds to 119 lakhs (190,000 USD) of power-saving at the rate Rs. 10/kWh (0.16 USD / kWh). At current prices, about 44 lakhs (69,576 USD) have been invested for setting up of dryers.

In the next five years we anticipate significant growth in the establishment of solar dryers and enhancement of dryers' capacity. With this, we envisage operation of more than 800 dryers of different capacities that can process more than 2700 tons of fruit bars. This may require an investment of 12 crores (1,897,533 USD) and 30 lakhs (47,438 USD) (including current investment), which can eliminate about 2,500 Mt of CO₂ emissions and may result in saving of Rs. 22 crores (3,478,810 USD) in terms of electricity valued at Rs. 10 per KW (0.16 USD / kW). The resources required for this would be primarily, private finance or own funding.

Conclusion

It is concluded that the pilot may be replicated in A- and B-grade cities of India and other Asian countries, as market is available for hygienic products. Self-Help Groups (SHGs) and individual women should be encouraged to take up the enterprise after proper training. The greatest positive factor of the enterprise is that it doesn't involve full-time engagement and thus could be taken up by daily laborers, housewives, or other women engaged with some other active source, for SHGs or individuals. Apart from this, it saves an enormous amount of rural produce from perishing.

Finally, it is concluded that the solar dryer use is suitable for wealth creation among poor women and plays a great role in reducing global warming. This could be easily replicated in all countries growing large amount of fruits and vegetables along with medicinal plants and with fish, which could be turned into value-added and hygienic products by solar drying.