

**Success story of Local Tunnel Solar Drier for small scale  
Entrepreneurship in Rural India**  
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**Abstract**

The paper presents the innovation of Shri Madan Lal Deora, a progressive farmer of Pali, district of Rajasthan in India who had established himself as a successful entrepreneur using self made tunnel solar drier. The solar tunnel dryer is a poly house framed structure with UV-stabilized polythene sheet, where products on large scale could be dried under controlled environment. The enterprise consists of different aonla products including juice, squash, candy, powder, pickle, dry aonla, churan tablets, preserve and ladoos. Aonla pulp from moisture content of 80.95 % to safe moisture content 9.0 % can be successfully dried in 2 days at the prevailing conditions in the drier. The enterprise manufactures two types of dry aonla, one is direct drying of green aonla which is used in a number of ayurvedic medicines and traditional drugs and another is the aonla dried after blanching which is used in as eating supplement of betel nut and as a mouth freshener. The farmer produces four types of preserve namely chutney preserve produced by making flakes of fruit ,preserve from big size fruits from improved cultivars, preserve from small size fruits from local cultivars and preserve aonla from which seeds had been removed. All the products are purely organic have high demand in the local and regional market.

**Introduction**

The new millennium brought into sharp focus the challenges expected of following a model of economic development based on excessive consumption of energy derived from fossil fuels. At the same time there was a threat from global warming, rising sea levels and climate change due to increasing atmospheric pollution caused by the Green House gases emission from economic activities based on fossil fuels. All these have only strengthened the view, which has gained wide currency in recent years that the process of economic development can not be sustained for long by relying on this model. Thus, there is an increasing realisation that the switchover to renewable sources to meet the growing energy needs of a burgeoning population can not be delayed any further. Clean and green power for sustainable development has become the motto. Fortunately India is blessed with abundant solar energy potential that can be used for different applications. In most of villages of rural India electricity supply is hardly 3-4 hours per day and as the cost of petro products is too high, hence there is need for exploration of renewable energy sources for environmental protection and sustainable development. The paper presents the innovation of a farmer of Pali district of Rajasthan in India who had made a local tunnel solar drier using his own knowledge using hit and trail method and he is now a successful entrepreneur having a local solar processing unit at his village Nimaz in Pali district of Rajasthan. In the month of December, solar radiation increases from 2.6 kWhm<sup>-2</sup>day<sup>-1</sup> to 4.5 kWhm<sup>-2</sup>day<sup>-1</sup> at Pali whereas during summer season i.e. March to May; this value ranges from 5.0 to 7.4 kWhm<sup>-2</sup>day<sup>-1</sup>. Pali receives 6.0 kWhm<sup>-2</sup>day<sup>-1</sup> global solar radiation

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and  $1.981 \text{ kWhm}^{-2}\text{day}^{-1}$  diffuse solar radiation on horizontal surface while  $6.272 \text{ kWhm}^{-2}\text{day}^{-1}$  direct solar radiation at normal incidence. The average daily duration of bright sunshine is 8- 9 hours.

In many rural areas of Rajasthan, the farmers grow fruit and vegetables, which have to be sold in the market immediately after harvesting. When the production is high, the farmers have to sell the material at very low price, there by incurring great loss. This loss can be minimised by dehydrating fruits and vegetables. The dried products can be stored for longer time in less volume. A successful enterprise can be run based on this principle which can easily utilize the surplus produce facing the seasonal glut. In off seasons the farmer can sell the dried products at higher price. The traditional methods for drying the agricultural produce are to dehydrate the material under direct sunshine. This method of drying is a slow process and usual problems like dust contamination, insect infestation and spoilage due to unexpected rain. These problems can be solved by using either oil-fired or gas fired or electrically operated dryers. However, in many rural locations in India, the electricity is either not available or too expensive for drying purpose. Thus in such areas the drying systems based on the electrical heating are inappropriate. Alternatively, fossil powered dryer can be used but it poses such financial barriers due to large initial and running cost that these are beyond the reach of small and marginal farmers. In the present energy crisis, it is desirable to apply a little solar technology for dehydration of fruits and vegetables, so that gas, oil and electricity can be saved. Keeping the above facts in mind this innovation of local drier can prove to be of much help to farmer of most of developing nations where sunshine is abundant. Moreover the products are easy to sell as the products are having high demand in local market also.

### **Local Tunnel Solar Dryer**

A semi circular shaped solar tunnel dryer having a floor area of  $5\text{m} \times 3.75\text{m}$  is designed for drying different processed products(Fig:1). The solar tunnel dryer is a poly house framed structure with UV-stabilized polythene sheet having height 2.25 meter, where products on large scale could be dried under controlled environment and which is large enough to permit a person to enter into it and carry out operations such as to load and unload the material to be dried. The orientation of tunnel solar dryer is in east-west direction and ultra violet stabilized polycarbonate / polythene sheet of 200-micron size is used as a cover material .



**Fig 1: Locally made solar tunnel drier**

The structural components of LTSD include hoops, foundation, floor, UV stabilized polythene film and drying trays. The LTSD consists of three inlets having radius of 15 cm each oriented in south west direction for entry of fresh air and three outlets at the top of the structure for the easy escape of hot air along with water vapour(Fig:2). The maximum temperature inside the domestic solar dryer reaches 44<sup>0</sup>C at 14 h while the minimum temperature inside the solar tunnel dryer was 20<sup>0</sup>C at 9 h on a typical day in winter season. While maximum and minimum ambient temperature were 26<sup>0</sup>C and 11<sup>0</sup>C respectively on that day. Cost wise the unit reaches Rs.25, 000/- per system respectively. Aonla pulp from moisture content of 80.95 % to safe moisture content 9.0 % can be successfully dried in 2 days at the prevailing conditions. The farmer is having about 1 hectares of land which is entirely covered with the plantation of aonla fruit plants planted at spacing of 6 X 6 M .The space left in between the plants is utilized for growing crops like wheat, mustard and vegetables like tomato, chillies, onion, garlic, *methi*, egg plant, okra etc, which supplies the requirement of his family besides giving handsome income from the nearby market. The main enterprise of the farmer is the processing unit of aonla which is well known for its organic and hygienic products. As the farmer is having his own orchard , raw material is no problem .His farm is well maintained having some 20 desi plants of aonla which give fruits which are small in size but they are much in demand due to their medicinal properties. Rest of the plantation is of a very good variety NA-7, which is evolved from Acharya Narendra Dev University of Agriculture and Technology, Faizabad, Utter Pradesh .This variety is excellent in taste, right green in colour with high juice and pulp content and minimum fibres.The different products manufactured by the farmer include juice, squash, candy, powder, pickle, dry aonla, churn tablets and preserve. He manufactures two types of dry aonla one is direct drying of green aonla which is used in a number of ayurvedic medicines and traditional drugs and another is the aonla dried after blanching which is used in as eating supplement of betel nut and as a mouth freshener. The farmer produces four types of preserve namely chutney preserve produced by making flakes of fruit ,preserve from big size fruits from improved cultivars, preserve from small size fruits from local cultivars and preserve aonla from which seeds had been removed. One product that is known to all and very much in demand is the Aonla *Ladoo/Burfis*. They are made by washing and grating of fresh aonla. This aonla is then roasted in pure butter oil and after cooling mixed with sugar and dry fruits. The product is then kept in solar drier for a day and then converted to either *laddoos* or *burfis*. Drying dehydrating vegetables viz. mint, spinach, okra, tomato, ginger, red and green chillies, carrot, coriander leaves, fenugreek, peas, cabbage, onion, sweet potato, bitter gourd, radish, sugar beet, cauliflower, *bathua* and fruits, viz. ber, sapodilla, grapes, pomegranate, etc. were also very successfully in the drier. The leafy vegetables can be dehydrated within one day at the loading rate of 4 to 5 kg/m<sup>2</sup>, whereas other vegetables can be dried within 2 days at loading rate of 8 to 10 kg/m<sup>2</sup>. The green colour of solar dried products remained as such even after drying. The spinach powder can be used for making ‘Palak paneer’ a special local dish. The coriander and tomato powder can be mixed with ingredients to prepare instant soup/sauce/chutney by adding water. The solar dried grated carrot can be used for preparing pudding ‘*Gajar ka Halwa*’. Thus the local tunnel solar drier is economically and environmentally profitable and need to be popularized in rural areas of India. This case study is in accordance with the findings of Lin (1997), who concluded that development of cottage and food processing enterprises industries is the need of developing nations in rural areas like India and Taiwan.



**Fig 2 :Drying conditions under the tunnel drier**

#### **Advantages of solar dryers**

- (i). Solar dryer can save fuel and electricity and drying time in solar dryer is reduced in comparison to open drying method.
- (ii). Fruits and vegetables dried in solar dryer are better in quality and hygienic than dried in open.
- (iii). Materials required for fabrication of solar dryer are locally available and the use of solar dryer involves no fire risks.
- (iv). The dryers can be connected in series and hence its capacity can be enhanced as per requirement and it can be dismantled easily so that its transportation is easy from one place to another.

#### **Social and economic impacts of entrepreneurship**

Mr Madan Lal had become a successful entrepreneur and now he is motivating other farmers also to adopt his path. The enterprise is having a selling counter at the farmers home itself where the local people come and take various products. As this is a small enterprise which does not have any branch, the outside parties also come in the village and take the processed product however. For the outside market the orders are placed in advance and the delivery is taken by the party itself. The farmer is earning 50,000 -80,000 profits a year besides providing employment to many needy persons. He had shown that by connecting agriculture with entrepreneurship one can easily sustain his living along with good savings. The positive results for social and economic aspects are also in close conformity with the study of Veerbhadrai *et al.*, (2003) who reported that entrepreneurship development programmes bring prosperity and raise the income of farmers in rural areas. Today madan lal employs 50 labours in his peak season for his aonla enterprise giving employment and social assistance to poor and weaker sections of the society. He had adopted a unique scheme for employment of workers at his enterprise that is he takes not more than one worker from each family so that every family has one earning hand; secondly he employs persons for one month only so that all the needy persons from his village may get chance to feed their families. Madan lal is inspiring his

own as well as nearby farmers to adopt entrepreneurship programme for their subsistence and livelihood. a surprisingly impact of the enterprise is he had won many awards and is a well known personality in social sector. As Mr Degra is adopting organic farming and processing, some of his products go to Delhi and far markets also.



**Fig 3: Processed products from solar drier**

**Table 1. Economies of Aonla dried in Farm Solar Dryer**

Initial investment	Rs 25000 /-
Purchase price of Aonla	5 Rs /Kg
Quantity loaded in one batch	25 Kg
Total purchase price	Rs.125/-
Other investment before drying	Rs. 25/-
Weight of dried product in one batch	2.5 Kg
Drying time of one batch	2 days
Earning /batch due to drying of Aonla in the farm solar dryer	525 Rs/batch
Saving per batch	Rs 400/-
Earning/drying day due to drying of Aonla in the farm solar dryer	200 Rs/ drying day

**Table 2. Economies of Aonla Candy dried in Farm Solar Dryer**

Initial investment	Rs 25000 /-
Purchase price of Aonla	5 Rs /Kg
Quantity loaded in one batch	20 Kg
Total purchase price	Rs.100/-
Other investment before drying(sugar, pectin ,spices etc)	Rs. 250/-
Labour, water, electricity(per batch)	Rs 160/

Drying time of one batch	2 day
Selling Price(Rs) per Kg	120
Total expenditure(Rs)	510
Earning /batch	1200 Rs/batch

**Table 3. Economies of Aonla ladoos/Burfi dried in Farm Solar Dryer**

Initial investment	Rs 25000 /-
Purchase price of Aonla	5 Rs /Kg
Quantity loaded in one batch	20 Kg
Total purchase price	Rs.100/-
Other investment before drying(sugar, butter oil, dry fruits etc)	Rs. 1000/-
Labour, water, electricity(per batch)	Rs 140/
Drying time of one batch	1 day
Selling Price(Rs) per Kg	100
Total expenditure(Rs)	1240/
Earning /batch	860 Rs/batch

### **Constraints**

Though Mr Madan lal is a successful entrepreneur but still he is facing certain problems which may be concluded as under:

- The seasonal nature of the enterprise
- Lack of marketing facilities
- Lack of trained manpower
- Delay of payment and mostly the mode of payment is on credit basis
- Lack of motivation and proper support from the government.

### **Conclusion**

The study concluded for a successful entrepreneur although professional training is important but it is the personal interest and effort of the individual which makes the difference. The findings of the present case study concluded that farmer's interest is the main criteria for a successful agro-enterprise. Entrepreneurship is also very important for Indian farmers as they are having small land holdings and a combination of agriculture along with small scale agriculture based entrepreneurship is the key to sustainable livelihood.