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ENHANCING LIVELIHOOD OF FARMERS THROUGH SUSTAINABLE TECHNOLOGIES



Preface

Agriculture is the backbone of Indian economy, being the world's largest producer of pulses and second largest producer of rice, wheat, fruits and vegetables. India's horticultural production reached 315 million metric tonnes (MMT) in 2018-19¹. However, the Ministry of Food Processing & Industries, Government of India (GOI) estimates the loss of total annual production around 15%. About 12 million tonnes of fruits and 21 million tonnes of vegetables, a total of USD 4.4 billion value, are wasted². The small and marginal farmers, who constitute 82% of the rural households dependent on agriculture for their livelihood, suffer the most³. One way to address the issue is to provide farmers with advanced post-harvest management technologies, which can increase the shelf-life of the produce and give farmers stronger bargaining power. Besides, these technologies bring a positive environmental impact. According to statistics, 6% of global greenhouse gas emissions come from food loss and waste⁴.

Covestro aims to make the world a brighter place, through its innovative and sustainable polymer solutions. In 2020, Covestro launched its new vision "We will be fully circular", aspiring to meet the interests of customers and consumers alike. With respect to sustainability, Covestro pursues a comprehensive approach that includes the entire product life cycle, taking into account social, environmental, and economic aspects. One of our five sustainability targets is to contribute to improving the lives of ten million people in underserved markets, primarily in developing and emerging countries, by the year 2025.

To this effect, Covestro works closely with different partners and stakeholders to bring a "sustainable social transformation" to the underserved communities. It addresses the post-harvest issue through innovative solutions, such as solar dryers and solar cold storages, which help reduce the post-harvest loss at farm by 10-15% and improve the earnings of the farmers by approximately 30%.

This narrative book includes some of the carefully chosen success stories from the ten million people. All the stories are true and presented as they are.

We would like to thank all our partners and beneficiaries for sharing the information, which enables us to bring them to life.

We are confident that these stories will inspire more farmers and key stakeholders to invest in such sustainable and innovative technologies.



Xiaobin Zhong

SVP CA Sales & Market Development APAC and Global Inclusive Business

1. Bearing Fruit: India's growing horticulture edge - The Financial Express

2. Fruit and Vegetable Peels: Utilization of High Value Horticultural Waste in Novel Industrial Applications (nih.gov)

3. India at a glance | FAO in India | Food and Agriculture Organization of the United Nations

4. Food waste is responsible for 6% of global greenhouse gas emissions - Our World in Data

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Solar Greenhouse Dryers

Paving the way for Agripreneurship



Solution

Solar Greenhouse Dryers are parabolic structure made of multi walled UV coated polycarbonate sheet, working on the principle of greenhouse effect. The secure closed structure preserves nutrients for longer periods without affecting the natural colour, aroma and texture of the produce. With a capacity to dehydrate a batch up to 2,000 kilos, it is suited for FPOs, and Agri enterprises. It helps efficient post-harvest management of horticulture produce, marine and meat products, enhancing their value.

- Provides efficient and hygienic drying method
- Preservation of aroma, colour and nutrients of produce
- Alternate market in the form of dehydrated products
- Protects the product from rain, dust, insect, common diseases, animal, birds, etc.
- Increases shelf-life of produce
- Reduces post-harvest losses
- Generates additional income for the farmers



Sustainability

Using this technology, has a positive impact on the environment. There is a significant reduction in the emission of greenhouse gases (methane produced during putrefaction is prevented by dehydration).

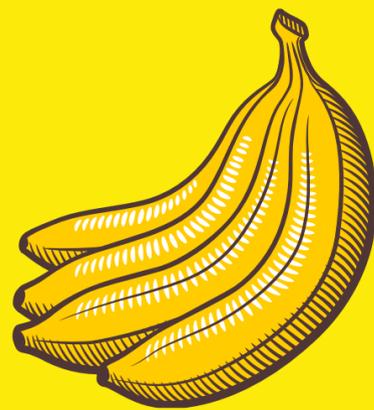


Scalability

An initiative that started in Tamil Nadu, has now propagated in the entire country. More than 500+ solutions have been installed and used for dehydrating more than 40+ commodities.

The solution is recognised by MNRE and empanelled under various schemes of the State Governments.

Pioneering with Bananas - bunch to brand



Trichy, Tamil Nadu

QUICK BITES

Adopted the polycarbonate based Solar Greenhouse Dryer (GHD) technology



The dehydrated banana increased revenue by **30%**

Developed presence on e-commerce platforms like Amazon and Q-trove



Post-harvest loss **30%**



Short shelf-life **3-4 days**



Price fluxes during the season

BACKGROUND

Thottiam Banana Producer Group (TBPG) is one of the primary producers of banana crop in the **Trichy** district of **Tamil Nadu** cultivating on 4000 acres of land. TBPG comprises of small and medium farmers, tenancy holders with an average land holding of less than one-hectare wet land that are irrigated by Cauvery River distributary canals.

Sweet Banana, the most popular variety in Trichy, Tamil Nadu has a short shelf-life since the harvesting season lasts for only 3 months. Thus, the harvesting season becomes an important part of the process i.e., when the fruits are fresh.



INTERVENTION

In 2014, the TBPG farmers adopted the polycarbonate based Solar Greenhouse Dryer technology.

IMPACT

Approximately 30% of the fruits, were getting wasted earlier:

Before adopting dehydration technology:

Total yield / acre : 1,12,000 fruits

Quantity sold in market (assuming 70%) : 78,400 fruits

Price of selling : ₹ 1.50 / fruit

Income earned by selling fresh fruits : ₹ 1,17,600

Post dehydration, the fruits are now sold in the market at ₹ 8 / fruit

After adopting dehydration technology:

Total yield / acre : 1,12,000 fruits

Quantity sold as dehydrated fruit (assuming 30% wasted) : 33,600 fruits

Price of selling : **₹ 8 / fruit**

Income earned by selling dehydrated fruits : **₹ 2,68,800**



As a result, the farmers group registered an additional income of ₹1,51,000 per annum



Increase in shelf-life **3 to 4 months**



ROI **2.5 years**



Using this dryer technology, several by-products such as dried whole banana, honey dipped dried banana, banana chewie, banana bars, banana rolls, banana powder, etc. were procured. Currently, **1000 members associated with this group, have benefitted using this process.**

CONCLUSION

TBPG are an AGRIPRENEUR now! They go by the name of **Madhur Fruits** on e-commerce platforms such as Amazon and Q-Trove. The growing market for dehydrated products indicates a huge potential for GHD in this sector.

Capitalizing on Copra & Peppercorn



Pattiveeranpatti,
Dindigul, Tamil Nadu

QUICK BITES



Dehydrated copra and pepper, earning an incremental income **₹ 3,73,000 / year**

Coconut oil yield increased by **11%**




The oil obtained is transparent and free from mold formation

Coconut - one of the most useful trees in the world, is often referred to as the 'Tree of Life'. The dried-up flesh of a coconut is called copra. Over a period of time, coconut based cropping system has emerged as a viable option to improve the economic status of coconut farmers.

Sharing a story of one such coconut farmer's capitalisation:

Farmer Name: **Mahesh Narayanan**

Location: Pattiveeranpatti village in Dindigul district of **Tamil Nadu**

Commodities dehydrated: **Coconut and Pepper**

BACKGROUND

Mr. Mahesh receives 1200 kg of coconut per year which are further de-shelled, broken open and are left to dry under a polycarbonate based Greenhouse Dryer. Further coconut oil is extracted in a wooden mill and sold in the market. Prior to this unique solution, it used to take 3 days to naturally dry the coconut.

With open sun-drying drying process, he faced a few challenges:

- Coconut is prone to be infested with dust, fungus, ants and other external factors.
- In monsoon, there is a huge risk of the dried coconuts getting rehydrated.



INTERVENTION

In December 2018, Mr. Mahesh adopted the polycarbonate based Solar Greenhouse Dryer technology for his farming.

IMPACT

Though this solution takes exactly 3 days like the natural drying process it is highly hygienic, effortless and provides enormous benefits in the long run. In the earlier process, on average 10% of the copra used to get wasted due to external factors.



Coconut	Before adopting greenhouse technology:	After adopting greenhouse technology:
Annual quantity of copra post dehydration	432 kg	480 kg
Annual yield of coconut oil	270 litres	300 litres
Price of coconut oil	₹ 320 / ltr	₹ 400 / ltr
Value of wastage	₹ 9,600	
Total income earned	₹ 86,400	₹ 1,20,000

The oil obtained from the dried coconuts was found to have better transparency and free of any molds / fungus. This helped Mr. Mahesh achieve a cost premium of 25%. He earns additional ₹ 4,800 by selling dried coconut shell at the market price of ₹ 4.

When these greenhouse dryers are not in use for coconut drying, Mr. Mahesh, uses it to dehydrate pepper berry to obtain black pepper corn.

Pepper berry yield received in a year
₹ 1,500 kg



Peppercorn	After adopting greenhouse technology:
Annual quantity of peppercorn post dehydration	525 kg
Price of black pepper (direct-to-home sales)	₹ 700 / kg
Total income earned	₹ 3,67,500

CONCLUSION

By adopting the polycarbonate based Greenhouse technology, Mr. Mahesh has created an additional revenue stream with pepper dehydration. This increased his current revenue by 3 times. In addition, for the past three years, he is successfully growing his own brand – **THENATURALFARMER** that focusses on selling organic products

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Revenue increased
5X



Improved
product quality

The benefits of dehydrated fruit basket



Krishnagiri,
Tamil Nadu

QUICK BITES

 Dehydration of fruits earned **74%** more profits over fresh fruits sale

Established a brand, **"MCI Agro Industries"** 

 Provided an additional income source for a community of 70 farmers



BACKGROUND

Krishnagiri situated at the bottom of Syed Basha hills in **Tamil Nadu** is very popular for its production of mangoes. The land is extremely fertile with access to fresh water to grow crops in abundance. However, the inadequate storage infrastructure do pose the challenge of high post-harvest loss.

Open sun drying is one of the traditional technique followed to improve shelf-life of commodities and with the region being blessed with more than 200 annual sunny days, it is an ideal place for dehydrating commodities.



INTERVENTION

Taking cue from this, Captain (Rtd.) T. Munirathinam, owner and promoter of **MCI Agro Industries**, started drying locally procured fruit in 2014, to be sold as dehydrated fruit candies. He used the polycarbonate based Solar Greenhouse Dryer to dehydrate the produce using naturally available solar energy. An initiative that started with 1 drier has now grown to 6 driers, each having a dried produce output of 1000 kg / month.

IMPACT

About 20% of fruits post-harvest gets wasted, rendering an economic loss for the farmers. These to-be-thrown away fruits are bought by MCI Agro Industries at market price and are converted to valuable dehydrated commodities.

A single batch requires approximately 3 days to get dehydrated.



CONCLUSION

With 6 driers operational, **MCI Agro Industries** earns a profit of ₹ 2,21,00,000 annually, which provides an additional income source for a community of 70 farmers. They are able to return their investment for each drier in about 2.5 months.



Post-harvest losses reduced by **20%**



Current drier units **6**



Farmers in operation **70**



ROI **2.5 months**



MCI Agro annual profit **₹ 2,21,00,000**

In this way, **MCI Agro Industries** have helped the farmers overcome crop wastage and created an alternate source of income.

	After adopting greenhouse technology:
Quantity dehydrated per batch (wet weight)	500 kg
Quantity dehydrated per batch (dry weight)	100 kg
Number of batches per year	120
Annual quantity dehydrated (wet weight)	60,000 kg
Average cost of wet produce	₹ 72 / kg
Cost of commodities procured	₹ 42,94,000
Annual quantity dehydrated (dry weight)	12,000 kg
Average sale price of dried produce	₹ 725 / kg
Annual revenue / dryer	₹ 86,94,000
No of labour per dryer per day	5
Active operational days	365 days
Annual cost of labour	₹ 6,57,000
Annual profit / dryer	₹ 36,97,000



Dehydrated Crop	Profit over fresh fruit sale (in Rs / kg)
Banana	9
Amla	4
Sugar added Mango	20
Sugar added Guava	5
Pineapple	12
Sugar added Apple	5
Grapes	16
Sugar added Papaya	15

Solar Powered Cold Storage

Aiding produce to stay fresh even in challenging times



Solution

Solar Cold Room Storage is a standalone portable cooling system that runs entirely using solar energy. Its unique thermal energy storage Phase Changing Material technology allows backup upto 30-32 hours. It enables to retain the quality of perishable produce and can be used in a pack-house, farmer markets and at a farm gate.

- Economical and environmental friendly energy source
- Extends the freshness of fruits, vegetables and other perishable food from 2 days to about 21 days; using solar energy only.
- Preserves aroma, colour and nutrients of produce
- Avoids distress sale of commodity
- Unique control system to precisely control temperature and relative humidity
- Suitable for all types of horticultural produce



Sustainability

Using this technology, has a positive impact on the environment. There is significant reduction in the emission of greenhouse gases and carbon footprint, by preventing decay of produce.



Scalability

The solution is well established in Maharashtra, Andhra Pradesh, Tamil Nadu, Telangana, Karnataka and is now finding acceptance in other states too. More than 200+ solutions have been installed accross Indian sub-continent.

The solution is recognised by MNRE and empanelled under various schemes of the State Governments.

Exuberance with Cucumber and Marigold



Mahbubnagar, Telangana

QUICK BITES

Adopted the polyurethane based Solar-powered Cold Storage (SCS) technology



Improved shelf-life of produce by **9-10 days**

Reduced post-harvest losses by **10%**



Earned an additional income of **₹ 3,18,000** / season



Cucumber

Annual yield: 38000 kg / acre

Shelf-life: 5 days

Harvest season: 4 months

Fresh produce rate: ₹ 20 / kg



Marigold

Annual yield: 8000 kg / acre

Shelf-life: 1.5 days

Harvest season: 3 months

Fresh produce rate: ₹ 25 / kg

BACKGROUND

Cucumbers are in-ground garden favourites. Sharing a story of our farmer from **Mahbubnagar, Telangana** who grows Cucumber along with Marigold as a companion crop.

As a fresh produce these crops have good value in the market, but being perishable in nature, they need to be sold forcibly, obtaining a lower price in the market. These crops face the risk of discolouration and suffer post harvest losses

INTERVENTION

By adopting the polyurethane based Solar-powered Cold Storage technology, the farmer managed to increase the shelf-life of these crops.



IMPACT

Approximately 10% of the produce, were getting wasted earlier due to unavailability of proper storage facility:



Additional income **₹ 3,18,000** / season



ROI **4-5 years**

Cucumber	Before adopting cold storage technology:	After adopting cold storage technology:
Quantity sold in market	38,000 kg	38,000 kg
Price of selling	₹ 20 / kg	₹ 25 / kg
Shelf-life	5 days	14 days 
Value of produce wasted	₹ 76,000	
Total income earned	₹ 6,84,000	₹9,50,000 

Marigold	Before adopting cold storage technology:	After adopting cold storage technology:
Quantity sold in market	8,000 kg	8,000 kg
Price of selling	₹ 25 / kg	₹ 40 / kg
Shelf-life	1.5 days	12 days 
Value of produce wasted	₹ 20,000	
Total income earned	₹ 1,80,000	₹ 3,20,000 

CONCLUSION

With the use of Solar powered Cold Storages, 100% of the produce can be sold in the market, thus fetching more income for the farmer.

By storing cucumber and marigold together using cold storage technology, the farmer will not only earn an additional income but also achieve a return on his investments. Since this technology help retain the characteristics of the produce, it has been well received in the market, reducing post-harvest losses.

Benefitting bloom of Dutch Rose



Ranga Reddy, Telangana

QUICK BITES

-  Improved shelf-life of produce by **11 days**
-  Reduced post-harvest losses by **10%**
-  Earned an additional income of **₹ 10,03,000 / year**



BACKGROUND

Rose, the "Queen of Flowers", is ranked first amongst the cut flower varieties in the international market. Among roses Dutch Rose has high demand owing to its high quality. A lot is dependent on the post-harvest technology that is deployed to retain the freshness of the Dutch rose in terms of colour and quality.

A farmer from **Ranga Reddy, Telangana** grows such kind of Dutch Roses in a 1-acre polyhouse having an annual yield of 6,60,000 sticks. However, these flowers are perishable and have a short shelf-life. Also, if the demand in the market is low, then these flowers wither away quickly or they face the risk of getting sold at a lower price.

INTERVENTION

Using the Solar-powered Cold Storage, it became possible for the farmer to preserve the Dutch Roses for 14 days.



IMPACT

Approximately 10% of the flower, were getting wasted earlier due to unavailability of proper storage facility:

Quantity sold in market

Price of selling

Shelf-life

Value of flower wasted

Total income earned

Before adopting cold storage technology:

6,60,000 sticks

₹ 2.5 per stick

3 days

₹ 66,000

₹ 15,84,000

After adopting cold storage technology:

6,60,000 sticks

₹ 4 per stick

14 days

₹ 26,40,000



Increase in income
₹ 1.5 per stick



Total additional income
₹ 10,03,000 annually



ROI
1.5 years

CONCLUSION

With the use of Solar powered Cold Storages, the characteristics of the flowers were retained and it was well received in the market, thus reducing post-harvest losses.

Bell Pepper rings profits



Pune, Maharashtra

QUICK BITES

-  Improved shelf-life of produce by **18 days**
-  Reduced post-harvest losses by **10%**
-  Earned an additional income of **₹ 6,21,000 / year**



BACKGROUND

Capsicum is a rich source of vitamin A, vitamin C and minerals, calcium, magnesium, phosphorus and potassium. Capsicum is a popular salad vegetable of which the coloured capsicums, grown under protected cultivation are in good demand in urban markets, mostly driven by high end consumers, hotel and catering industry, used widely in fast food preparations.

One such farmer in **Pune, Maharashtra** grows 35,000 kg colour capsicum annually under 1 acre of polyhouse. Being perishable with a short shelf-life, it gets spoiled or discoloured easily. When the demand in the market is low, it renders an economic loss or faces the risk of being sold at a lower price



Shelf-life **3 days** approx.



Market price of fresh capsicum **₹ 40 / kg**

INTERVENTION

The polyurethane based Solar-powered Cold Storage technology helped to preserve the colour capsicum, for up to 21 days. This provided value addition by increasing the shelf-life of the crop through pre-cooling mechanism and reducing post-harvest losses.

IMPACT

Approximately 10% of the crops, were getting wasted earlier due to unavailability of proper storage facility:

Quantity sold in market

Price of selling

Shelf-life

Value of crop wasted

Total income earned

Before adopting cold storage technology:

35,000 kg

₹ 40 / kg

3 days

₹ 1,40,000

₹ 12,60,000

After adopting cold storage technology:

35,000 kg

₹ 55 / kg

21 days

₹ 19,25,000



Increase in shelf-life **21 days**



Increase in rates **₹ 15 / kg**



Additional annual income **₹ 6,21,000**



ROI **2.5 years**

CONCLUSION

By storing colour capsicum using cold storage technology, the farmer could store good quality produce and sell it collectively in the market, thereby enabling additional income for the farmer. Since the

characteristics of the crop were retained, the farmer could connect to markets in Pune and Ahmedabad, enabling him to tap the right market.

Gerbera smells success



Patna, Bihar

QUICK BITES

-  Improved shelf-life of produce by **9 days**
-  Reduced post-harvest losses by **10%**
-  Earned an additional income of **₹ 9,18,000 / year**



BACKGROUND

Gerbera, an exotic ornamental flower is commercially grown across the world in a wide range of climatic conditions and is also known as African Daisy. According to the global trends in floriculture, Gerbera occupies 4th place among cut flowers. Due to the freshness and long-lasting features, this flower is used widely in all kinds of ornamental decoration. As such, it has an excellent market commercial value in India.

A farmer from **Patna, Bihar** is growing these flowers under a 1 acre polyhouse. Currently, his annual yield is 8,80,000 sticks. The biggest challenge of commercially growing this flower is its short shelf-life and if the demand is low, the delicate nature of this flower makes it really difficult for the farmer to sell and earn any economic value from it.



Short shelf-life **3 days** approx.



Low price per stick **₹ 2.5**

INTERVENTION

Using the polyurethane based Solar-powered Cold Storage technology, the farmer was able to preserve the gerbera up to 12 days, enabling him to earn the right value for the flower.

IMPACT

Approximately 10% of the flower, were getting wasted earlier due to unavailability of proper storage facility:

Quantity sold in market

Price of selling

Shelf-life

Value of flower wasted

Total income earned

Before adopting cold storage technology:

8,80,000 sticks

₹ 2.5 per stick

3 days

₹ 88,000

₹ 21,12,000

After adopting cold storage technology:

8,80,000 sticks

₹ 3.5 per stick

12 days

₹ 30,80,000



New price earned **₹ 3.5** per stick



Additional income annually **₹ 9,18,000**



ROI **1.7 years**



Post-harvest losses reduced **10%**

CONCLUSION

The use of Solar-powered Cold Storage made it possible for the farmer to preserve 100% of his flowers and sell it in the market at a premium.

The pre-cooled Gerbera retained its freshness and characteristics, hence was readily received by the market.

Fruits are healthy, and commercially cool



Parbhani, Maharashtra

QUICK BITES

-  Improved shelf-life of produce upto **10 days**
-  Reduced post-harvest losses by **15%**
-  Earned an additional revenue of **₹ 14,06,300 / year**



BACKGROUND

Parbhani district in Maharashtra consists of 8 talukas, one of them being Manwath, from where our farmer Mr. Sandip Also belongs. Most of the people here are engaged in agricultural activities for their livelihood. The soil is rich in plant nutrients which supports the growth of a variety of crops.

When the market demand is high, the farmers receive a good price for their horticulture crop. However, due to short shelf-life of the crop, the farmers are forced to sell their crops at a price as low as ₹ 5 / kg.

INTERVENTION

In 2015, Mr. Sandip adopted the polyurethane based Solar-powered Cold Storage technology that has helped him increase the shelf-life of the produce by 6-10 days. He can now easily store his produce when the market rate is low and sell it at an appropriate time.

-  Selling **flexibility**
-  Reduction in **logistic costs**
-  Increase in shelf-life by **6-15 days**

IMPACT

In about 20-22 acre of farm, Mr. Sandip grows five horticulture crops namely Raw Mango, Tomato, Watermelon, Orange and Guava. On an average, before availability of cold storage, he used to experience 15% post-harvest loss. Now he is able to store the produce for up to 15 days / month, to obtain a correct price in the market. The cold storage facility is seen to be maximally utilised from October to February. Additionally, he needs to travel approx. 35km to reach the mandi, to sell his produce.

 Mr. Sandip's farm land **20-22 acre**

 Produce post-harvest loss before the use of technology – **15%**



Crops	Quantity / season (in kg)	Price of produce at time of storage (₹ / kg)	Price of produce after Cold storage (₹ / kg)
Raw Mango (used for pickle)	7500	30	60
Tomato	42000	5	13
Watermelon	24000	5	20
Orange	10000	15	50
Guava	9000	5	20
Total revenue		₹ 7,50,000	₹ 21,56,000

Transportation cost:

Distance from nearby mandi	35 km
Cost / trip	₹ 900
Number of trips / year	100
Total transportation cost / year	₹ 90,000



CONCLUSION

100% of the produce could be stored and sold in the market, at the right time, with the use of Solar-powered Cold Storages. This solution has not only helped Mr. Sandip, but also a nearby farmer, who stores their Lemon in this cold storage, to earn 6 times more income.

 ROI **1 year**

 Additional revenue **₹14,06,300**

Dried Figs make it big



Pusuluru Village,
Andhra Pradesh

QUICK BITES

Adopted the polycarbonate based Greenhouse Solar Dryer (GHD) and polyurethane based Solar-powered Cold Storage (SCS) technology



Dehydrated and stored the fruits, to increase revenue by **30%** per season



Increased shelf-life up to **6-8 months**



Earned an additional revenue of **₹ 3,70,000** / over sale of fresh fruits



Shelf-life of Figs
3 days



Price of fresh Figs
₹ 55 / kg

BACKGROUND

The farmers in **Pusuluru Village, Andhra Pradesh, India** have adopted a new technology of selling the Asiatic origin fruit, Fig (Anjeer), to increase their income. One such farmer Mr. Ramanjaneya, along with his fellow FPO farmers, is cultivating Anjeer in his 3 acres farm yielding 200 fresh fruits per acre.

Figs are well known as a nutritional fruit rich in calcium and fibre. They are used by practitioners of Indian Medicine to treat conditions affecting respiratory, digestive, immune system, etc. However, fresh figs are perishable in nature and have a very short shelf-life.

Challenges faced:

- Owing to the shorter shelf-life of Figs, it needs to be sold forcibly
- Once it gets stale and discoloured, it renders no economic value for the farmers
- With fluctuating prices during the season, the revenue is further impacted

INTERVENTION

These farmers adopted the polycarbonate based Greenhouse Solar Dryer technology and polyurethane based Solar-powered Cold Storage technology. Using these solution, the value of the fruits and shelf-life were increased, through dehydration and pre-cooling mechanism. This unique combination helped Mr. Ramanjaneya dehydrate the fruit and store it for up to a year, until it was the right time to sell in the market

IMPACT

Before adopting dehydration technology:

Total yield / 3 acre	6,000 kg
Quantity sold as fresh fruit	6,000 kg
Price of selling	₹ 55 / kg
Revenue earned by selling fresh fruits / 3 acre	₹ 3,30,000

After adopting GHD + CS solution

Post dehydration and cooling, the fruits are sold in the market at **₹ 700 / kg**. Two case scenarios are considered for evaluating the value addition of dehydrated figs.

Note: In both the scenarios, there is an approximate loss of 10%, due to personal handling and transfer.



	Adopting GHD and SCS technology separately	Adopting GHD and SCS technology together
Dehydrated fruit quantity (wet weight) / 3 acre	6000 kg	6000 kg
Dehydrated fruit quantity (dry weight) / 3 acre	1000 kg	1000 kg
Dehydrated fruit shelf-life	1 month	6-8 months
% wasted if not sold in market (assumption)	10%	0%
Quantity of dehydrated fruit sold in market / 3 acre	900 kg	1000 kg
Price of dehydrated fruit	₹ 700 / kg	₹ 700 / kg
Net revenue earned by sale of dehydrated fruit / 3 acre	₹ 6,30,000	₹ 7,00,000



Combined time taken for ROI on both solutions:
3.8 years approx.



Farmer revenue increased
30% per season

CONCLUSION

Using these solutions, the farmers were able to achieve an increase in their revenue. Additionally, Mr. Ramanjaneya was also connected to markets in Kochi, Bangalore and Ananthapur, who readily accepted the dried anjeer / figs as its good quality was preserved using cold storage. The FPO, "Sri Ramanjaneya Swamy Anjeer Products and Marketing Mutually Aided Cooperative Society Ltd." that started with 16 members has now grown to 60 members.

Solar Conduction Dryers

Empowering the lives of farmers



Solution

The Solar Conduction Dryer works on principles of conduction, convection and radiation for heat transfer, preserving 45 percent more nutritional value in fruits and vegetables than conventional dryers. These dehydration units are portable, do not occupy much space and reduce the drying time by 30-60%.

- Efficient and hygienic drying process
- Produce prevented from being affected by animals, rain, dust, insect and common diseases, encountered while open drying
- Preservation of aroma, colour and nutrients of produce
- Increases shelf-life of produce upto 6-12 months
- Post-harvest loss reduced upto 40%
- Customizable load capacity of 3kg - 1000kg
- It is suitable for individual farmers, SHGs, JLGs, etc.
- Uses polycarbonate and polyurethane material as an insulation material



Sustainability

Using this technology, has a positive impact on the environment. There is significant reduction in the emission of greenhouse gases and carbon footprint, by preventing decay of produce.



Scalability

An initiative that started in Maharashtra is now being propagated in other states too. More than 1500+ solutions have been installed across Indian sub-continent.

The solution is recognised by MNRE and empanelled under various schemes of the State Governments.

More from the "Miracle Tree"



Surajpur, Chhattisgarh

QUICK BITES

Adopted the polycarbonate and polyurethane based Solar Conduction Dryer (SCD) technology



Developed a home brand "Surajpur Moringa Powder"

Helped 1200+ children overcome malnourishment



Earned an additional annual revenue of approximately ₹ 2,00,000



BACKGROUND

Moringa, often known as the "Miracle Tree," is grown all over the world and is widely used as food and medicine. Nearly every part of the moringa tree is edible.

Rich in : Antioxidants and nutrients along with vitamin A, C & E, Moringa also contains calcium, iron and potassium.

When dried, the leaves can be grinded into fine powder and kept for many months without refrigeration. One of the self-help groups from **Surajpur district in Chhattisgarh**, are dehydrating moringa leaves and selling them as powder to a nearby bakery, where it is processed into various eatables like moringa bread, cookies, toast, etc. and supplied to 'Aanganwaadi Centers.'

Malnourishment has been a grave issue in the district. About 14000 children up to 6 years old were found to be malnourished and being from a low economic background, their families couldn't do much to improve the situation.

INTERVENTION

They started with 1 unit of the polycarbonate and polyurethane based Solar Conduction Dryer (SCD) in 2019, providing work, training and wages for a few under privileged local women.



IMPACT

After experiencing a positive response, in 2020, they purchased two more units of hybrid Solar Conduction Dryer. Now, in the last one and a half years, they have helped about 1200 children to overcome plight of malnourishment.



Annual profit ₹ 5,61,000



ROI 4 months



1200 children overcame malnourishment



Employment generation for about 68 women

	After adopting solar conduction dryer
Annual quantity dehydrated (wet weight)	24000 kg
Cost of moringa leaves	₹ 8 / kg
Total cost of purchase	₹ 1,92,000
Annual quantity dehydrated (dry weight)	2400 kg
Price of selling dried moringa powder	₹ 1000 / kg
Annual revenue	₹ 24,00,000
Active operational days per month	10 days
Approximate no. of women involved	68
Daily wages per women	₹ 200
Annual cost of labour	₹ 16,32,000
Annual profit earned	₹ 5,61,000



CONCLUSION

With the usage of a single SCD unit, the SHG not only made monumental profit but also achieved a ROI in quick period. Apart from Moringa, they are also exploring dehydration possibilities for crops such as Jackfruit, Lemon grass, Tulsi, etc.

In this way, the SHG in Surajpur district of Chhattisgarh, is setting a perfect example for the quote, "Big things have small beginnings" - T.E. Lawrence.

The change in *Chikoo's* (Sapota) worth



Dahanu, Palghar, Maharashtra

QUICK BITES



Developed a home brand "**Gold Orchards Chikoo**"

Explored a new market opportunity of dried **chikoo powder**



Earned an additional total annual revenue of approximately **₹ 2,00,000**



INTERVENTION

In 2016, the farmers started with 1 unit of the polycarbonate and polyurethane based Solar Conduction Dryer (SCD) and set up a local brand selling dehydrated chikoo. Realizing the benefits, they purchased 2 more units and expanded their circle to 12 other farmers, having a total of 15 units now. This enabled them to establish a brand called 'Gold Orchards Chikoo.'

BACKGROUND

Chikoo also known as Sapota is grown abundantly in the states of Karnataka, Tamil Nadu, Gujarat, Maharashtra and West Bengal in India

Rich in : Fibre, vitamin A & C, tannin compound, helps fight bacterial infection, boost immunity

The entire belt heading towards **Dahanu in Palghar** district, produces about 30,000 tonnes of Chikoo annually. The economy of the region survives on its sapota plantations and has generated employment for all in terms of agricultural labour, trading, processing, packaging, transportation

Like all fruits, Chikoo too has a short shelf-life and if not picked well on time, the ripen fruits gets wasted. Mrs. Latika Achyut Patil, a farmer from Dahanu have been processing and dehydrating these ripened chikoo since 15 years by the traditional method of open sun drying.

However, open sun drying process of Chikoo has its own issues as stated below:

- The dehydrated chikoo used to get infested by external factors
- It led to bacteria & mold formation, turning black in appearance
- It reduced the product quality leading to an economic loss

2016 when it started

1 unit

1 Farmer

2021 - Now

3 units

12 Farmers

IMPACT

Mrs. Latika Achyut Patil along with her daughter-in-law Mrs. Vidula Ninad Patil owns an 8-acre land, where they grow Chikoo. Out of this approx. 71% was sold as fresh in the market. **In the earlier open sun drying process, only 0.5% of the low grade fruits were dehydrated as against 4% now using SCD**



The Gold Orchards Chikoo is also positively impacting the lives of stakeholders across the value chain. Dried chikoo chunks are supplied to kulfi makers and milkshake providers. This has been a boon, since there is no uncertainty of chikoo ripening and there are huge savings on labour. Dried chikoo powder has also found a convincing audience amongst Mithai / Sweet makers. Apart from chikoo, they also have 15-20 other products including caramalised banana, curry leaves, mint leaves, etc. All of these products are 100% natural, contain no added sugar, flavour, chemicals, additives or preservatives.

	Before adopting SCD	After adopting SCD
Annual quantity available for dehydration (wet weight)	10800 kg	10800 kg
Quantity processed annually (wet weight)	540 kg	2160 kg
Annual quantity in excess (wet weight)	10260 kg	8640 kg
Value lost (average price of ₹ 10 considered)	₹ 102600	₹ 86400
Annual quantity post dehydration (dry weight)	108 kg	432 kg
40% is sold in B2B market and 60% in B2C market		
Price of selling in B2B	₹ 400 / kg	₹ 400 / kg
Quantity sold as B2B	43 kg	173 kg
Price of selling in B2C	₹ 800 / kg	₹ 800 / kg
Quantity sold as B2C	65 kg	260 kg
Total revenue earned	₹ 69,120	₹ 2,76,480

By adopting the solar conduction dryer, not only could the farmers earn an incremental profit and recover their investment, they were also able to explore a new market opportunity of dried chikoo powder. In the earlier open sun drying process, powdered chikoo could not be formulated as the water content in the sun dried chikoo used to make the powder sticky, but by dehydrating the chikoo chunks in SCD for further two days, it could be powdered. This product segment is expected to grow up to 40%.



Profit per unit

₹ 67,450



ROI

1.5 years

CONCLUSION

This example exhibits the value addition created in the entire value chain by the use of SCD. It has provided employment opportunities, reduced storage and labour cost, and added a new feather to Dahanu's agri tourism.

Super Profit from Super Food Ragi (Finger Millet)



Aurangabad, Maharashtra

QUICK BITES



Developed a home brand "Saurabh Gruh Udyog"

Provided an annual income of ₹ 27,000 for 4 women



Earned an incremental annual profit of approximately ₹ 1,41,500



Organisation name
Saurabh Gruh Udyog



Value addition -
Ragi Malt



Employees
4 women



BACKGROUND

Ragi also known as Finger Millet / Nachini is considered to be a 'Super Food', due to its nutritional contents. The hull of the ragi grain is indigestible and therefore the grain is usually hulled before use. However, this process does not reduce the nutritional content. The grain is then used as it is, or ground into flour, which is then used to make some healthy sweets and savories.

Wholesome Ragi

Rich in carbs, fat, fibre, protein

Key micronutrient, vitamins, minerals

Low on cholesterol and sodium



Mrs. Shubangi Kulkarni, one of our business women from **Aurangabad** is doing the Ragi business since 2014. She has been dehydrating ragi sprouts, sieving and grinding them to sell as ragi malt, with and without sugar. She has built a small-scale company that also sells other products apart from Ragi malt.

INTERVENTION

Mrs. Kulkarni started with 1 unit of Solar Conduction Dryer (SCD), started with 1 unit of polycarbonate and polyurethane based SCD technology. On experiencing success, they then added one more unit to double their capacity.

IMPACT

This initiative has yielded an annual income generation of about ₹ 27,000 for each of the 4 women employed.



CONCLUSION

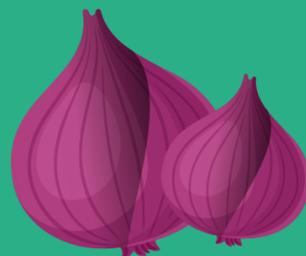
With the usage of a single SCD unit for ragi, "Saurabh Gruh Udyog" could earn an incremental profit of ₹ 1,41,500 / year, with a return on investment in approximately 5 months.



	After adopting solar conduction dryer
Annual quantity dehydrated (wet weight)	7200 kg
Cost of ragi	₹ 35 / kg
Total cost of purchase	₹ 2,52,000
Annual quantity dehydrated (dry weight)	2880 kg
Dehydrated output / day	8 kg
Active operational days per month	360 days
Price of selling ragi powder	₹ 225 / kg
Annual revenue	₹ 6,48,000
No. of women involved	4
Annual wages per women	₹ 27000
Annual cost of manpower	₹ 1,08,000
Annual profit	₹ 2,83,000



More power to cow colostrum



Satana Village, Nashik ,
Maharashtra

QUICK BITES



Explored a market of dehydrated **colostrum powder**

Increased his annual revenue by **6 times**



Value added to **twin bulb onions**



No. of cows
160



Twin bulb onion yield
0.4%



Price of twin bulb onions if not dehydrated
₹ 4 / kg



BACKGROUND

Cows and calves are essential to the livelihood and culture of small holder farmers in rural India. Cows are milked for home consumption and sale of milk, providing an essential protein source, particularly for children, allowing a regular cash income. Bovine Colostrum, a fluid produced by a cattle just after giving birth to a calf, is considered to be highly nutritious for human consumption.

Colostrum supplements are prepared, by pasteurizing and drying it into pills or powders, which can be consumed by mixing it with liquids. It typically has a yellow colour and a subtle taste and smell, resembling buttermilk.

Mr. Aniruddha is one of our farmers from **Satana village, Nashik** who owns Gir cows and produces colostrum powder, under the name "**Saraja Dairy Farm**". He also dehydrates twin bulb onions, which constitutes about 0.4% of the total onion yield. These onions if not dehydrated, are wasted or are sold at a low price of ₹ 4 / kg.

Benefits of colostrum

Highly nutritious

Rich in vitamins, minerals, fats, carbs

Disease fighting proteins

Immunity booster

INTERVENTION

By adopting 1 unit of polycarbonate and polyurethane based Solar Conduction Dryer (SCD), Mr. Aniruddha could create value addition in cow colostrum and onions by dehydrating them.

IMPACT

The solar drier is used to produce colostrum powder for a period of 4 months. On an average he receives 1600 litres of colostrum milk annually, which when sold at ₹ 100 / litre earns him an annual revenue of ₹ 1,60,000. After adopting the SCD technology, he started separating the solids from colostrum milk and dehydrated it to produce colostrum powder.



The dehydrated twin bulb onions helped Mr. Aniruddha achieve a profit of ₹ 7000 over fresh onion sale. This activity stretches for about 3 months.

CONCLUSION

By utilising the SCD for 7 months in a year, excluding monsoon and winter months, Mr. Aniruddha increased his collective revenue by 6 times. He has also been honoured with the Gopalratna Award, which is the highest civilian award in Gopalan in our country.

	After adopting solar conduction dryer
Colostrum	
Annual quantity of colostrum dehydrated (wet weight)	1600 kg
Annual quantity of colostrum dehydrated (dry weight)	160 kg
Time required for drying / batch	2 days
Capacity / batch (wet weight)	30 kg
Dehydrated output / batch	3 kg
Selling price	₹ 7000 / kg
Revenue earned over 4 months	₹ 11,20,000
Onion	
Annual quantity dehydrated (wet weight)	2000 kg
Annual quantity dehydrated (dry weight)	200 kg
Time required for drying / batch	1.5 days
Capacity / batch (wet weight)	35 kg
Dehydrated output / batch	3.5 kg
Selling price	₹ 175 / kg
Revenue earned over 3 months	₹ 35,000



Activity duration

7 months



Total revenue increased annually

6x

A fruitful medley of redeemed value



Nashik, Maharashtra

QUICK BITES



Increased shelf-life of produce up to **6 months**

Offered employment generation to **4-5 women**



Earned an additional profit of ₹ **2,50,000** / annum from dehydration



BACKGROUND

Nashik is one of the fastest growing cities in India. Often referred as the 'Wine Capital of India' since more than half of the country's vineyards are located here.

Nashik is a significant vegetable growing region with crops like onion, brinjal, okra, bitter gourd, tomato, etc. Due to the perishable nature of the crops, the farmers force sell their produce at throw away prices, incurring huge losses.

Mr. Goverdhan Kulkarni a farmer from Ozar village in Nashik district, has found a way to overcome this challenge. In 2013, he started a FPO named, **Shri Sant Savta Shetkari Gut (SSSG)**, consisting of 25 farmers from the region. They dehydrated the low value produce which were sold at a meagre price of ₹ 3-4 / kg and obtained a better value proposition in the market.

INTERVENTION

In 2014, Mr. Kulkarni acquired the polycarbonate and polyurethane based Solar Conduction Dryer (SCD) technology which helped him to dehydrate the produce in a hygienic and efficient manner. These dehydrated commodities could now be stored for up to 6 months without any spoilage. Realising the benefits, the FPO have increased their operations capacity by adding more SCD units.



Current operational units **50 SCD**



Dehydration capacity **20 kg** per unit per batch.

IMPACT

The low-grade produce received a low price in the market due to its physical deformities, colour variations, etc., but they were still rich in nutritional content. When dehydrated and powdered, the same produce earned 5 times more revenue for the farmers.

A single batch of SCD can accommodate 20kg of wet produce, with each batch requiring approximately 3 days for dehydration.



Revenue increased **5X**



Shelf-life improved to **6 months**

CONCLUSION

With the help of SCD technology, the SSSG FPO sold 17 different types of dehydrated vegetables and leaves to earn an annual incremental profit of ₹ 5,000 per SCD, with a return on investment in 4 years. They promote their initiative through innovative slogans like, "**Smart Kitchen ki Smart Bhaji**" and "**Avoid non-veg, try dry veg**".

This activity that stretches for about 6 months in a year, not only reduces the post-harvest losses, but also leads to employment generation. Currently, **about 4-5 women labourers are employed, each earning an annual additional income of ₹ 40,500 / season.**

In this way, this story perfectly resonates with Henry Ford's quote, "Coming together is a beginning. Keeping together is progress. Working together is success."

	After adopting solar conduction dryer
Annual quantity dehydrated (wet weight)	45,000 kg
Wet: dry ratio	18:1
Annual quantity dehydrated (dry weight)	2,500 kg
Operational cost inclusive of labour, packaging and maintenance	₹ 200 / kg
Total operating cost	₹ 5,00,000
Average price of selling dehydrated produce	₹ 300 / kg
Total revenue	₹ 7,50,000



Abbreviations:

- FPO - Farmer Producer Organisation
- GHD - Solar Green House Dryers
- MNRE - Ministry of New and Renewable Industry
- SCD - Solar Conduction Dryers
- SCS - Solar Cold Storage
- SHG - Self Help Group
- SSSG - Shri Sant Savta Shetkari Gut
- TBPG - Thottiyam Banana Producer Group

Accreditations:



Our Solar greenhouse dryer solution have been recognized and featured as a "UNSDG good practice" by the United Nations Department of Economic and Social Affairs. Based on their website, globally, only about 450 such solutions have been featured so far.



Our Solar greenhouse dryer solution has received the "Solar Impulse Efficient Solutions Label", where it has been proven as economically profitable and environmentally protective solution.

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