

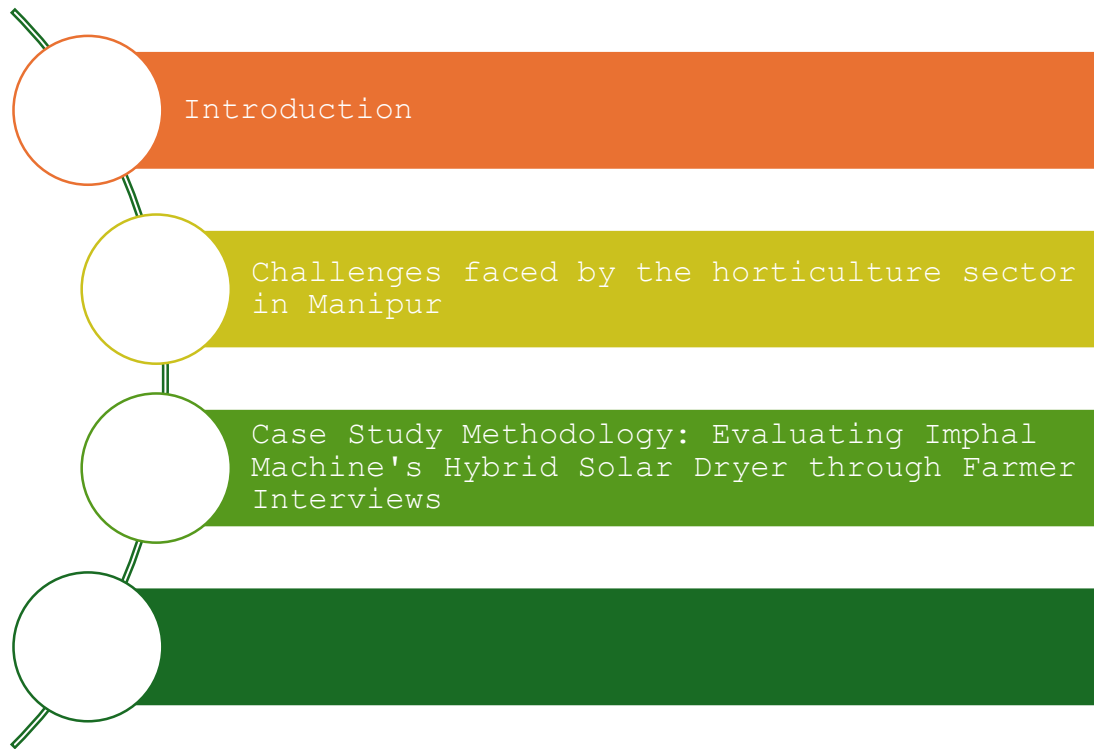


CASE STUDY

HYBRID DRYERS
(SOLAR AND
ELECTRICAL)
USED FOR
DRYING OF
HORTICULTURE
PRODUCTS IN
MANIPUR

Imphal Machines OPC Pvt. Ltd.

SELCO Foundation



A CASE STUDY FOR HYBRID DRYERS (SOLAR AND ELECTRICAL) USED FOR DRYING OF HORTICULTURE PRODUCTS IN MANIPUR

INTRODUCTION:

Sun drying of agricultural products is the traditional method employed in most of the developing countries. Sun drying is used to denote the exposure of a commodity to direct solar radiation and the convective power of the natural wind. Sun drying offers a cheap method of drying but often results to inferior quality of products due to its dependence of weather conditions and vulnerably to the attack of dust, dirt, rains, insects, pests, and microorganisms (Esper A, Muhlbauer W.,1998). In natural convection solar dryers, the air flow is due to buoyancy-induced air pressure, and the drying process needs some days to complete, as a cabinet dryer needs 3–4 days to dry grapes (Sharma VK, Sharma S, Ray RA, Garg HP,1986). While in forced convection solar dryers the air flow is provided by using a fan either operated by electricity/solar module or fossil fuel (Hossain MA, Bala BK,2007)



Fig.1 Traditional way of drying (getty image)

An auxiliary heat and forced convection are recommended for assuring reliability and better control, respectively. However, there exist some problems associated with solar drying i.e. reliability of solar radiation during rainy period or cloudy days and its unavailability at nighttime. In a hybrid solar dryer, drying is continued during off sunshine hours by back-up heat energy or storage heat energy. Therefore, drying is continued and the product is saved from possible deterioration by microbial infestation (Arinze EA, Schoenau GJ, Sokhansanj S.,1999 & Bala BK, Woods JL,1994)

Some hybrid dryers were developed to control the drying air conditions throughout the drying time independent of sunshine especially at night when it is not possible to use the solar energy using alternative sawdust burner, (Bassey MW,1985) or by using a biomass stove (Prasad J, Vijay VK,2005). It is reported that significant improvement was registered after the heater is added to the solar dryer during periods of low sunshine (Bennamoun L, Belhamri A,2003 & Janjai S, Praditwong P. ,1992). Tasmparlis ,1990 was found that using the hybrid solar dryer connected by heating unit (20 kW) was reduced the drying time of the grapes to 30–40 h and the air velocity of 0.8 m/s produced by fan was homogeneous but small, which results in slow drying rates, hence large drying periods, also the quality for the dried fruits was very high. A solar assisted hybrid drier was developed in Asian Institute of Technology, Thailand for drying of fruits and vegetables. The drier is a tunnel type and back-up energy were provided with biomass burning during off sunshine period (Mastekbayeva GA, Bhatta CP, Leon AM, Kumar S.,1999).

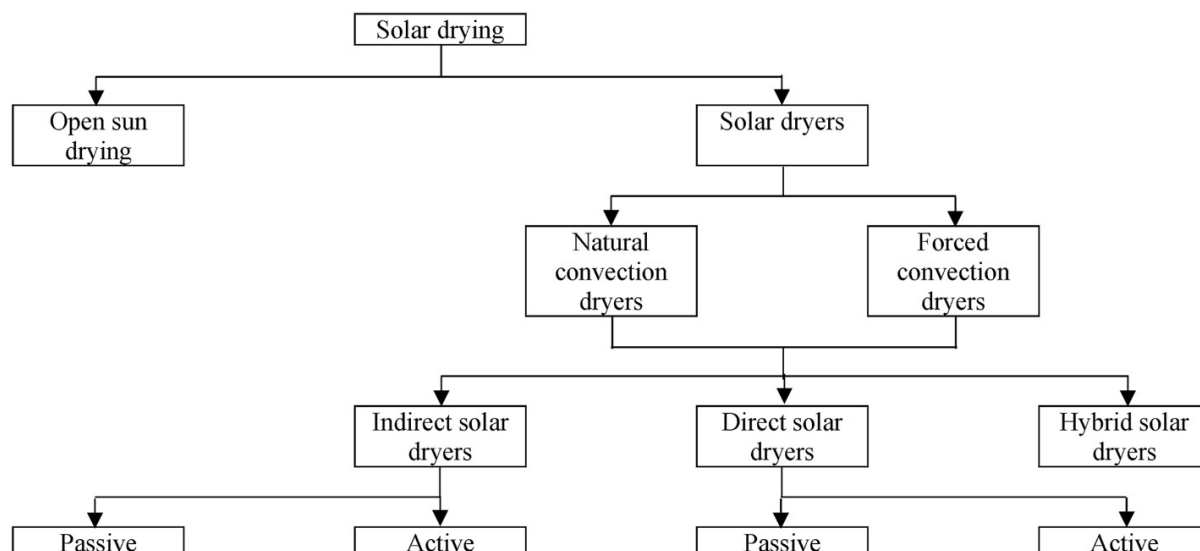


Fig.2 Classification of solar dryers (P. Udomkun et.al 2020)

CHALLENGES FACED BY THE HORTICULTURE SECTOR IN MANIPUR:

Manipur is suitable for the development of the horticultural based farming system. Besides, there is ample scope for bringing more land under fruits and vegetable cultivation in the hilly areas as well as in the valley. Manipur reported production of 913.104 ton of horticulture crops in the year 2023 (Source: CEICDATA). In the absence of proper storage technique, the farmers usually sell their vegetables in the local markets soon after the harvest. Transporting their crop in gunny bags on local transport to markets induced considerable stress on them. Upkeep and storage of fruits and vegetables are most crucial postharvest activity. Due to lack of sufficient storage and processing facilities in most of Manipur, the significant number of fruits and vegetables are being damaged after harvest. Losses of harvested produce occur in both ways qualitative as well as quantitative. The sun drying of food material is one of the oldest agricultural methods related to food storage, but every year, millions of rupees worth of gross product are lost through spoilage. Reasons include ignorance about the preservation of produce, inadequate transportation systems during the harvest season, and the low price the rural farmer receives for their products during the seasons of harvest. Drying of farm produce can change this trend and is used in most of the remote areas, especially those areas with lack of storage and scarcity of power supply, due to this problem; there is difficulty in expanding of the modern storage facility. Unfortunately, many of the rural areas in the state that could be benefited from the solar drying technology lack sufficient information related to how to extend this technology and which technology to use under certain conditions. Many of the latest solar drying technology, as well as significant achievements are not available to reach the farmers level and areas of greatest need (S Roma Devi & Kanta Singh,2018).

Considering the challenges, the primary objective of conducting a case study on the hybrid solar dryer manufactured by Imphal Machine, located at Imphal, Manipur is to comprehensively evaluate the performance, efficiency, and practicality of the technology in various real-world scenarios in the state.

Case Study Methodology: Evaluating Imphal Machine's Hybrid Solar Dryer through Farmer Interviews

1.Selection of Participants:

Three farmers who have recently purchased and are actively using Imphal Machine's hybrid solar dryer for agricultural product were identified based on of geographical location, crops dried, and farm size to capture a range of perspectives to ensure diversity.

2.Pre-Interview Questionnaire:

We developed a pre-interview questionnaire to collect background information on the farmers, including farm size, crops grown, drying methods used before adopting the hybrid solar dryer, and initial expectations from the technology.

3.On-Site Visits:

Conducted on-site visits to the selected farmers' locations to observe the hybrid solar dryer in action for documentation of the setup, including the placement of the dryer, power sources, and any auxiliary equipment.

4.Structured Interviews:

Structured interviews were conducted with the participating farmers, focusing on key aspects:

- Performance: The drying efficiency, time taken, and quality of dried products.
- Economic Impact: The initial investment, operational costs, and perceived economic benefits.
- User Experience: Feedback on ease of use, maintenance requirements, and overall satisfaction.
- Adaptability: Understanding how well the hybrid solar dryer suits the local climate and farming practices.
- Challenges: Any challenges faced during installation, operation, or integration into their existing processes.

5.Data Collection Tools:

We utilized a mix of data collection tools, including interviews, observation checklists, and photographic documentation to provide a comprehensive overview.

6. Analysis and Documentation:

The collected data is analysed to identify common trends, success factors, and challenges including a detailed description of each farmer's experience, key findings, and recommendations.

7.Observation:

Drying duration for different vegetable, fruits, and spices crop under hybrid solar dryer and open sunny days/traditional drying (table)

a) Name of entrepreneur: Nongthombam Premananda Singh

Location: Lalambung Makhong, Imphal, Manipur



Fig.3 On-site feedback reviews from Mr.Premananda

SL NO	VEGETABLE/FRUIT	DRYING UNDER HYBRID SOLAR DRYER	DRYING UNDER OPEN SUNNY DAYS/TRADITIONAL DRYING
1	Peruk (<i>Centella asiatica</i>)	3 days	5-7 days
2	Pineapple Slices	5-6 days	8-10 days
3	Apple Slices	5 days	7-8 days
4	Cucumber	3 days	5-6 days
5	King Chilli (U-Morok)	7 days	11-13 days
6	Coriander leaves	2 days	4-5 days

b) Name of entrepreneur: Luxmi Laishram

Location: Langthabal, Imphal, Manipur



Fig.4 On-site feedback reviews from Mrs.Luxmi Laishram

SL NO	VEGETABLE/FRUIT	DRYING UNDER HYBRID SOLAR DRYER	DRYING UNDER OPEN SUNNY DAYS/TRADITIONAL DRYING
1	Amla (<i>Heiku</i>) Slices	2 days	4-5 days
2	Wild Apple (<i>Heitup</i>) Slices	2-3 days	5-6 days
3	Wild Mango (<i>Heining</i>) Slices	2-3 days	7-8 days
4	Seasonal Fruit slices	3-4 days	5-6 days

c) Name of entrepreneur: Catherine Soyamphi AS

Location: Ukhrul, Manipur



Fig.5 On-site feedback reviews from Miss Catherine Soyamphi

SL NO	VEGETABLE/FRUIT	DRYING UNDER HYBRID SOLAR DRYER	DRYING UNDER OPEN SUNNY DAYS/TRADITIONAL DRYING
1	Gooseberries Slices	2 days	4-5 days
2	Wild Apple (<i>Heitup</i>) Slices	2-3 days	5-6 days
3	Wild Olive Slices	2-3 days	7-8 days
4	Plum	2-3 days	5-6 days
5	Kiwi	2-3 days	5-6 days

Summary of On-Site Reviews from Selected Entrepreneurs:

1. General Satisfaction:

- All three entrepreneurs express overall satisfaction with the quality of the final products achieved by the hybrid solar dryer. They note improvements in color and overall flavor compared to traditional drying methods.

2. Efficiency and Profit Improvement:

- There is a consensus among the entrepreneurs that the hybrid solar dryer has significantly improved the efficiency of their drying processes. This improvement is directly linked to an increase in profits, indicating a positive impact on their businesses.

3. Premananda's Feedback:

- Premananda is satisfied with the dryer's performance but requests improvements in the air circulation system and the ergonomics of the dryer. Additionally, he desires more flexibility in the design of drying trays.

4. Mrs. Luxmi Laishram's Feedback:

- Mrs. Luxmi Laishram shares a similar concern with the drying trays, calling for improvements. However, she expresses satisfaction with the dryer's performance, particularly highlighting its effectiveness during windy days.

5. Miss Catherine's Feedback:

- Miss Catherine, situated in a hilly district, faces challenges during hailstorms and frequent load shedding days. She suggests enhancing the effectiveness of the lower layer of trays to address these issues. Despite these challenges, she remains positive about the overall impact on her business.

6. Common Themes:

- Flexibility in drying trays emerges as a common theme across the entrepreneurs' feedback.
- The impact of weather conditions, including wind and hailstorms, is noted as a consideration for further improvements.

7. Positive Overall Impact:

- Despite the specific improvement requests, all three entrepreneurs express a positive overall impact of the hybrid solar dryer on their businesses compared to traditional drying methods. This sentiment suggests a general satisfaction with the technology and its contribution to their profitability.

8. Usage of Solar Dryers:

- The entrepreneurs acknowledge the benefits of using solar dryers compared to traditional methods, highlighting the advantages of renewable energy in the drying process.

Incorporating these insights into the case study will provide a nuanced understanding of the hybrid solar dryer's strengths, areas for improvement, and its tangible impact on businesses in different geographical and climatic contexts.

8. Conclusion:

In the journey to harness sustainable and efficient solutions for agricultural processing, the on-site reviews from three dedicated entrepreneurs using Imphal Machine's hybrid solar dryer provide valuable insights. The unanimous satisfaction with the quality of the final products,

marked improvements in efficiency, and a noticeable boost in profits underscore the positive impact of this innovative drying technology on businesses.

While Premananda emphasises the need for enhancements in the air circulation system and ergonomics, coupled with a call for more flexible drying trays, Mrs. Luxmi Laishram and Miss Catherine echo the sentiment, particularly emphasising improvements in the design of drying trays. Each entrepreneur brings a unique perspective, showcasing the diversity of challenges faced in different geographic locations, from windy days to hailstorms and frequent power outages.

Despite these challenges, the resilience and optimism displayed by these entrepreneurs reflect a broader consensus—Imphal Machine's hybrid solar dryer has significantly transformed their traditional drying methods, aligning with their goals of sustainability and profitability. The positive feedback on product quality, coupled with the acknowledgement of solar dryers' advantages over conventional methods, reinforces the technology's promising trajectory in the agricultural processing landscape.

As we conclude this case study, it becomes evident that the journey towards sustainable agriculture requires an iterative approach, listening to the voices of entrepreneurs on the ground and continually refining technologies to meet their specific needs. Imphal Machine's hybrid solar dryer stands as a testament to innovation, creating a positive ripple effect that not only enhances the efficiency of agricultural processes but also contributes to the economic well-being of entrepreneurs.

The specific improvement suggestions from these entrepreneurs serve as a roadmap for future enhancements, ensuring that the technology evolves to meet the diverse challenges faced by businesses in different regions. This case study highlights not only the success of the hybrid solar dryer in its current state but also the potential for further refinement and adaptation to various climatic and operational conditions.

In conclusion, the collaboration between technology developers, entrepreneurs, and agricultural innovators fosters a dynamic ecosystem where sustainable solutions like Imphal Machine's hybrid solar dryer can continue to thrive and make a lasting impact on the future of agricultural processing.

