Access to Cooling
Cold Storage solutions for Agriculture and Animal Husbandry
Agriculture & Food Processing

- Cold Storage: Horticulture, Floriculture, Meat and Fish
- Refrigerator: Retail Storage of Beverages, Animal Products and Vegetables

Vaccine Storage
- Vaccine Carrier
- Portable Storage
- Stationary Storage

Animal Husbandry
- Milk Chillers
- Dairy Product Storage

Dairy
- Vaccine Carrier
- Portable Storage
- Stationary Storage

Retail Storage of Beverages, Animal Products and Vegetables

Poultry, Goats and Cows
India is the largest producer of milk, the second largest producer of vegetables, fruits & flowers, third largest producer of fish and fifth largest producer of eggs, all perishable commodities.

- The food spoilage rates (~30%) in India are one of the world’s highest due to inefficient cold-chain network (caused by unreliable electricity, poor infrastructure and inaccessibility to small-holder farmers).

- The varied shelf life and storage conditions of commodities makes it difficult for farmers to analyse their production, market dynamics and react to sell their produce. Additional stress on farmers is engaging with harvest during day and travel long distances at night to sell in market.

- There is currently no access to farm/village level cold storages. Large units are quite often located in large cities and often controlled by middlemen. Farm/village level cold storage can assist farmers in aggregation and store produce to ride through price glut.

Access to finance and minimal use of farm cold storage during non-harvesting cycles is a challenge if such farm cold storages are proposed to be bought by individual farmers. Tackling this requires a strategy of financing and owning cold storage solutions using alternative group based/participative community models.
Currently Available Agricultural Cold Storage Solutions

### ECOZEN

<table>
<thead>
<tr>
<th>Type of structure</th>
<th>0.5 mm steel sheet</th>
<th>PPGI</th>
</tr>
</thead>
<tbody>
<tr>
<td>External dimensions (L x W x H)</td>
<td>20 ft. x 8 ft. x 8 ft.</td>
<td></td>
</tr>
<tr>
<td>Internal / Storage Volume</td>
<td>760 cu. ft.</td>
<td></td>
</tr>
<tr>
<td>Cold room insulation thickness</td>
<td>100mm</td>
<td></td>
</tr>
<tr>
<td>Storage capacity</td>
<td>5 MT</td>
<td></td>
</tr>
<tr>
<td>Pre - cooling capacity</td>
<td>0.75 MT</td>
<td></td>
</tr>
<tr>
<td>Refrigeration TR</td>
<td>~ 2.7 TR at - 5 °C (Evaporating &amp; 50 °C condensing)</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>4 - 15 °C (using set point control)</td>
<td></td>
</tr>
<tr>
<td>Humidity range</td>
<td>65 - 95% (using set point control)</td>
<td></td>
</tr>
<tr>
<td>Loading rate</td>
<td>10-18% of total capacity (500-750 kg of produce per day)</td>
<td></td>
</tr>
<tr>
<td>Door opening</td>
<td>20-30 minutes in a day</td>
<td></td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Source of energy</td>
<td>Solar or Grid</td>
<td></td>
</tr>
</tbody>
</table>

**Cost of the cold storage with Thermal Back up**  
Rs. 16,00,830/- inclusive of solar, battery & power converters, also 5 years AMC

### INFICOLD

<table>
<thead>
<tr>
<th>Type of structure</th>
<th>ISO Marine Container with Solar Panels Mounted on the roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>External dimensions (L x W x H)</td>
<td>20 ft x 8 ft x 9.5 ft</td>
</tr>
<tr>
<td>Internal / Storage Volume</td>
<td>750 cu. Ft</td>
</tr>
<tr>
<td>Cold room insulation thickness</td>
<td>100 mm</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>5 MT</td>
</tr>
<tr>
<td>Pre - cooling capacity</td>
<td>1.25 MT (daily) 5 MT (occasional)</td>
</tr>
<tr>
<td>Refrigeration TR</td>
<td>2.25 TR at - 5 °C (Evaporating and 40 °C ambient)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>4 - 15 °C</td>
</tr>
<tr>
<td>Humidity range</td>
<td>90 - 95%</td>
</tr>
<tr>
<td>Loading rate</td>
<td>1250 BH kg per day</td>
</tr>
<tr>
<td>Door opening</td>
<td>8 per day for 30 sec each</td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>Yes</td>
</tr>
<tr>
<td>Source of energy</td>
<td>Solar or Grid</td>
</tr>
</tbody>
</table>

**Cost of the cold storage with Thermal Back up**  
Rs. 14,60,000/-

---

**ECOZEN**  
Rs. 16,00,830/- inclusive of solar, battery & power converters, also 5 years AMC

**INFICOLD**  
Rs. 14,60,000/-
**COOL CROP**

- **Internal / Storage Volume**: 960 cu. ft
- **Cold room insulation thickness**: 60mm - 80mm
- **Storage capacity**: 5 - 6 MT
- **Refrigeration TR**: 1 TR
- **Temperature range**: 0 °C - 18 °C
- **Humidity range**: 65% - 90%
- **Loading rate**: 1200 kgs per day
- **Remote monitoring**: Yes
- **Solar array capacity**: 7 kWp
- **Auxiliary battery**: 100 Ah, 48 V
- **Material for Backup**: PCM lined on walls
- **Backup duration**: Custom made depending on the requirement
- **Warranty**: 1 year warranty on workmanship, 3 years depending on the piece of equipment, 1 year of remote monitoring free of charge, the customer can add additional time to the warranty duration
- **Availability**: India
- **Models**: Full payment
- **AMC**: Rs. 13,140/-
- **Services provided per year**: 2 Service
- **Delivery duration**: 45 days

---

**PLUSS ADVANCED TECHNOLOGIES**

- **Internal / Storage Volume**: 760 cu. ft
- **Cold room insulation thickness**: 100 mm
- **Storage capacity**: 5 MT
- **Refrigeration TR**: 2.5 TR
- **Temperature range**: 2 °C - 8 °C
- **Remote monitoring**: Yes
- **Source of energy**: Solar or Grid
- **Solar array capacity**: 4.48 kWp
- **Auxiliary battery**: 100 Ah, 12 V
- **Material for Backup**: PCM lined on walls
- **Backup duration**: Custom made depending on the requirement
- **Warranty**: 1 year
- **Availability**: India
- **AMC**: Rs. 13,140/-
- **Services provided per year**: 2 Service
- **Delivery duration**: 30 days

---

**INNOCOOL**

- **Type of structure**: Shipping container
- **External dimensions (L x W x H)**: 20 ft x 8 ft x 8 ft
- **Internal / Storage Volume**: 1024 cu. ft
- **Storage capacity**: 5 MT
- **Refrigeration TR**: ~1.28 TR @ -5 deg 50 deg cond
- **Temperature range**: 2 °C - 8 °C
- **Remote monitoring**: Yes
- **Source of energy**: Solar
- **Solar array capacity**: 3.6 kW

---

**INSPIRA FARMS**

- **Internal / Storage Volume**: 323 sq. ft to 1292 sq. ft.
- **Pre-cooling Capacity**: 8 to 12 hours
- **Temperature range**: 2 °C - 14 °C
- **Backup**: Solar & Grid - 1 phase or Diesel Generator
- **Material for Backup**: Ice as thermal Storage medium
- **Backup duration**: 18 - 24 hours
- **Alternative power type**: Diesel generator/ Grid
- **Warranty**: 1 year (expandable)
- **Availability**: Middle East & Africa. In not available areas procure normal cold room & only buy electronics

---

**VACKER GLOBAL**

- **Internal / Storage Volume**: 24 sq. ft (minimum size)
- **Temperature range**: 0 °C - 15 °C
- **Source of energy**: Solar & Grid - 1 phase or Diesel Generator
- **Warranty**: 2 years (for electronic circuit)
- **Availability**: Middle East & Africa. In not available areas procure normal cold room & only buy electronics
Ownership and Procurement Models for Agricultural Cold Storage Solutions

**Type of Institution**
- Farmer Group
- SHG or Users Collective
- Individuals and Pvt. Institution
- Panchayat (Local Govt.)
- Other Village Institution. (Eg. Village Forest Committee)

**Type of Procurement Financing**
- Lease to Own
- Upfront Payment with Govt. or Philanthropic Grants & Subsidies, w/w.o loans
- Upfront Payment w/w.o loans

**Type of Business**
- Local Procurement of vegetable and fruit produce, storage and selling back into local markets
- Rental Model - Farmers, community members lease shelf space in cold storage units
- Self Consumption for a large institution
- Trader Model - Local procurement, storage and sales to external markets
Policies for Cold Storage Solutions

**National Horticulture Mission (NHM)**

Cold storage (long term storage and distribution hubs) up to 5000 MT capacity are eligible for assistance under the open ended scheme of NHM/ HMNEH (a sub scheme of MIDH). The assistance is extended as subsidies to credit linked projects @ 35% of capital cost of project in general area and 50% in case of Hilly & Scheduled area.

**Small Farmer Agri-Business Consortium (SFAC) Assistance to Cold Storage**

Setting up of cold storage as a part of an integrated value chain project are eligible for subsidy provided the cold storage component is not more than 75% of TFO (Total Financial Outlay). The scale of assistance as subsidy to projects is @ 25% of capital cost and maximum ceiling to Rs 2.25 crores in general area and 33.33% and maximum ceiling up to Rs 4 crores in case of NE, Hilly & Scheduled area.

**Scheme of Cold Chain, Value Addition and Preservation Infrastructure (MOFPI)**

For storage infrastructure including Pack House and Pre cooling unit, ripening chamber and transport infrastructure, grant-in-aid at 35% for General Areas and at 50% for North East States, Himalayan States, ITDP Areas & Islands, of the total cost of plant & machinery and technical civil works will be provided.

**National Agriculture Development Programme/Rashtriya Krishi Vikas Yojana (RKVY)**

RKVY Funds will be made available to the States in two installments of 50% each. Eligibility & Inter-State allocation criteria will not be applied for providing funds under the sub-schemes of RKVY or RKVY Special schemes. State Governments will also determine sectoral classification for investment requirements for infrastructure in public, public-private and private sectors and accordingly work out financial support for funding gaps in infrastructure taking into account viability gap which would be based on financial analysis. However, in any case, subsidy will be capped to 25% of total project cost.
Case Study 1
Harsha Trust, Odisha
Markama Agri Producer Company Ltd

INSTITUTION
Markama Agri Producer Company Ltd is a Farmer Producer Organisation (FPO) set up in 2016 with an objective to provide an organised market to the farmers of Bissamcuttack, Rayagada, Odisha.

INPUT & OUTPUT LINKAGES
With the help of a NGO - Harsha Trusts set up an agro-business group which supports farmers with agro-based input – fertilisers and seasonal vegetables as well as collectivisation, storage and sales of farm produce.

Via the NGO’s activities, the farmers were encouraged to carry out extensive vegetable cultivation and aggregation of marketable commodities. Due to the increased influx of produced commodities, prices in local markets took a dip, which increased the dependency of the farmers on local traders for higher returns. To provide a higher share of returns to farmers the agro-business group began the process of collectivisation, cold storage and built market linkages to external markets for higher returns.

The group now also gauges market trends and gives inputs to farmers on which crops to produce for maximum returns.

PROCUREMENT FINANCING
The cold storage unit utilised for procured using a lease to own model using grants issued to Harsha Trust to pilot cold storage solutions for gauging operational processes. Upon viability assessment, Harsha Trust utilised additional grant funds to purchase the cold storage unit after a year of testing.

TECHNOLOGY
The FPO uses Ecozen’s Ecofrost - A solar micro cold storage unit which is a small scale - 6 MT, solar powered cold room meant to store fresh fruits, vegetable, flowers, processed food and other perishable commodities. The unit enables both pre-cooling and storage of perishables to preserve their freshness and maximise shelf life.

LEARNINGS
- Green Vegetable Commodities like Cabbage, Cauliflower, Chilli and Cauliflower are less volatile and provide more definite returns compared to more volatile commodities like Tomatoes which may require a higher degree of management and price prediction.
- Avg. Utilisation of units is low, with average storage at 22 kgs/day which provides a monthly average revenue of Rs. 1100. An average utilisation of 200-250 kgs/day would be recommended to generate ample profits, for paying back a minimum of 50% of the capital cost at 5% interest p.a for a period of 10 years.
Case Study 2
CINI, Jharkhand
Murhu Nari Shakti Kishan Producer Company Ltd

INSITUATION
A Farmer Producer Organisation set up by CINI an NGO in Jharkhand carries out the cold storage business on behalf of its farmer members.

INPUT & OUTPUT LINKAGES
With the help of CINI, Farmers in Khunti carry out a cold storage business. The group had originally planned to provide a pay per use service to farmers who would want to store their produce for a longer duration of time and gain a higher margin of returns. However, due to low volumes associated with this model, it was soon rejected.

The group now functions as a trader, purchasing vegetables and fruits locally, storing them to gain higher value and thereafter selling the produce in larger markets, thus gaining profits.

PROCUREMENT FINANCING
The cold storage unit utilised for procured using grants issued to CINI to pilot cold storage solutions for gauging operational processes.

TECHNOLOGY
The FPO uses Ecozen’s Ecofrost - A solar micro cold storage unit which is a small scale - 5 MT, solar powered cold room meant to store fresh fruits, vegetable, flowers, processed food and other perishable commodities. The unit enables both pre-cooling and storage of perishables to preserve their freshness and maximise shelf life.

LEARNINGS
• Rental models would require a large farmer pool cultivating vegetables and fruits continuously in large quantities to be viable.
• The burden of predicting prices and returns would lie with every individual farmer, inhibiting adoption of the technology.
• Trader models work more effectively to ensure higher capacity utilisations. This could be a bridge program until local farmer produce is increased or could be used as a hybrid model. Via trading 11 Tonnes of tomatoes, cucumbers and chilli, the FPO has gained profits worth Rs. 34000+ in a month, which would be enough to pay for a loan over a ten year loan cycle.
Case Study 3
Karnataka
Samsthana Shree Mahabaleshwar Temple

INSITUTION
Samsthana Shree Mahabaleshwar Temple, Gokarna is well known temple where devotees from all over India will visit and pray for their well-being.

INPUT & OUTPUT LINKAGES
The temple has undertaken Amrutanna Prasad Bhojan section for preparing free food for lunch & dinner for more than 2000 devotees daily. The temple lacks a cold storage unit for preserving Vegetables, Milk & Coconuts due to which they incur huge loss.

Types of commodities stored
• Vegetables – 30 bags of 60 kg; Vegetables are bought on a weekly basis from local markets.
• Coconut – 3000 to 4000 numbers; Coconuts are also bought on a weekly basis.
• Milk – 50 litre to 100 litre; Milk is bought daily.

PROCUREMENT FINANCING
The cold storage unit utilised for procured partially using grants issued to the temple to pilot cold storage solutions for gauging operational processes. 30% of the expenditure was borne by the temple.

TECHNOLOGY
The temple uses Inficold’s solar micro cold storage unit which is a small scale - 6 MT, solar powered cold room meant to store fresh fruits, vegetable, flowers, processed food and other perishable commodities. The unit enables both pre-cooling and storage of perishables to preserve their freshness and maximise shelf life.

LEARNINGS
• The wastage of the vegetable and coconut have reduced drastically as before 800 kg of vegetables & 500 pieces of coconut was decaying due to the warm and humid climate
• The temple management is now buying vegetables & fruits in bulk which in turn saves the investment on commodities when purchased in smaller volumes and separately.
• Based on the analysis it can be suggested for further implementation at various other sites like community kitchens, prasad bhojana shalas, in supply chain mechanisms, etc. across various geographies.
Vaccination is the most critical component that plays an important role to reduce livestock mortality and increase the income of the farmer. It is generally seen that almost 15% - 20% morality in livestock happens due to diseases in some places entire herd is swept away.

The vaccination of above described livestock disease is usually carried out by animal husbandry departments and local NGO’s. It has to be considered that the availability of vaccines, required human resource for doing it and the refrigerators for storing these vaccines are essential part of any vaccination program. Often erratic power supply disrupts the cold chain resulting in ineffectiveness of vaccination which results in high mortality despite vaccination. This also has social implications as the end user may lose their interest in vaccination.

Mortality for animal offsprings is a major problem for the small ruminants and poultry like goat, poultry and sheep which counts upto 70% in the normal condition and upto 90% in extreme conditions. Offspring mortality is exclusively due to lack of proper basic animal health care practices like vaccination and deworming. The proper vaccination and deworming can bring the kid mortality down to 20% by following the proper schedule. Managing proper cold chain especially for vaccines is a challenge in the most remote pockets of South Odisha.

Considerations for installing vaccine refrigerator and passive boxes

1. Activity of farmer (Goat rearing or Poultry or both).
2. Numbers of existing farmers in a cluster.
3. Transportation time required for vaccines from central storage to end user.
4. The business models- Operational costs, Profits/Salaries etc.
5. Expansion/replication opportunity.
Case Study 4
Odisha

INSITUTION
An FPO has been now engaged to ensure proper vaccination and deworming of major livestock through village saturation approach by maintaining proper cold chain through solar operated refrigeration system. The producer companies started providing the infrastructure for maintaining the cold chain and a chargeable service offering by creating a successful enterprise.

INPUT & OUTPUT LINKAGES
Harsha Trust an NGO with operations in Bissumcuttuck, Odisha has promoted large scale livestock rearing with landless households through FPOs in areas of South Odisha. To maintain steady income the herd size of the livestock has to be maintained through out the year.

Harsha Trust has producer companies which deploy service providers for livestock vaccination and deworming services around livestock. These vaccines are procured from producer companies or vendors and stored in solar operated vaccine chambers. The village level service provider cadre ensures vaccination of all the goats and poultry available in the village at a time.

TECHNOLOGY
The FPO uses Godrej Surechill - a range of solar direct drive DC vaccine refrigerators. These completely off grid refrigerators offer better temperature and power stability with control. The long battery life and power backup autonomy making them suitable for vaccine storage in off grid areas.

LEARNINGS
• Vaccines are procured from producer companies or vendors and stored in solar operated vaccine chambers. The village level service provider cadre ensures vaccination of all the goats and poultry available in the village at a time.

• Each beneficiary pays Re 1 for deworming per poultry bird and Rs 2/- for vaccination of the birds. Similarly, for goats the prices are Rs 2/- for deworming and Rs 5/- for vaccination respectively. In case of bulk purchase the cost of deworming and vaccination for both poultry and goats is substantially reduced to Rs 0.50 and added to that is the service charge of Rs 0.50.
Milk contains numerous nutrients and makes a significant contribution in meeting the human body's needs for calcium, riboflavin, magnesium, selenium, vitamin B12 and pantothenic acid (vitamin B5). It is also one of the few consistent income sources for farmers. However, as soon as milk leaves the udder of mammal, the bacteria in it start multiplying exponentially, which deteriorates the quality of milk by converting the lactose or sugar in the milk into lactic acid. It curdles the proteins and causes souring.

The hygienic quality of fresh milk is determined by milk handling practices at the milk producer level and the cooling practices at the milk collection centers. Poor-quality of milk at the collection level cannot be corrected further up the dairy value chain. Therefore, it is very important that cooling should be done within one/one-and-half hour of milking, after which the naturally occurring preservatives in the milk (including carbon dioxide) stop working.

Case Study 5
Bamul, Karnataka

BANGALORE URBAN, BANGALORE RURAL AND RAMANAGARA DISTRICT COOPERATIVE MILK PRODUCERS SOCIETY UNION LTD. (BAMUL)

INSITUTION
The Milk union in Bangalore currently uses bulk cooling tanks to cool their milk to about 4 degree Celsius at their procurement centres. The tanks is of 3000 liters capacity, keep the milk chilled till the tanker from the dairy arrives.

INPUT & OUTPUT LINKAGES
They collect milk from 55 farmers around 5km radius. The farmers reach the centre 1 hour after milking so it requires an instant chilling to store it longer. Bulk coolers require the electric back-up via diesel generator set as 3 phase electric grid supply is not reliable. 2.5 litre of diesel was required in a day. The diesel generator associated with these coolers are oversized by up to 5 times the rated power of compressor just to handle the startup surge requirements. It results in additional diesel consumption due to part load operation.

LEARNINGS
- Annual Fuel savings – 900 litres of Diesel with Generators. Saved diesel of Rs. 5,000 per month (Rs. 60,000 per annum on diesel)
- Milk quality has improved and is now eligible for UHT production - Increased Income of Rs. 7,30,000 per annum on improved milk quality
Access to Cooling
Cold Storage solutions for Agriculture and Animal Husbandry

SELCO FOUNDATION
www.selcofoundation.org
info@selcofoundation.org