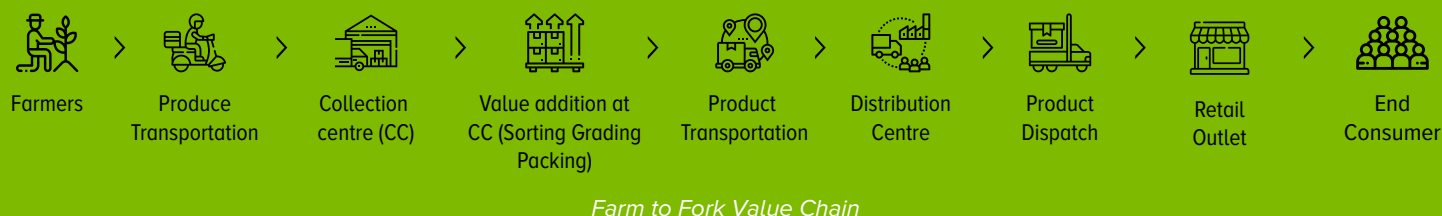


# Improving Rural Livelihoods Through Energy-Efficient Cooling & Refrigeration in India



## CONTEXT

While it is said that India has almost reached self-sufficiency in agricultural produce, it is still ranked 101 out of 116 countries in the 2021 Global Hunger Index<sup>1</sup> and 71 out of 113 countries in the Global Food Security (GFS) Index 2021<sup>2</sup>. The lack of proper integrated cold chain infrastructure, specifically the absence of adequate cooling and refrigeration technologies and post-harvest infrastructure in rural agricultural communities at a) farm-gate (point of harvest), b) collection point (aggregation), c) during transit d) at wholesale and distribution points and e) retail, results in a significant post-harvest loss in India.



The alarming post-harvest loss adversely impacts the income of the agricultural workforce, which constitutes 54.6% of India's total workforce (Census 2011 data), contributing around 17.8% of the country's Gross Value Added (GVA) for the year 2019-20 (at current prices)<sup>3</sup>. Small and marginal land-holder farmers, who constitute 86%<sup>4</sup> of all farmers in India and own about half the arable land, are most affected by the lack of affordable post-harvest management facilities. The lack of affordable storage facilities compels farmers to either sell their produce at a lower cost or face produce spoilage and loss. The post-harvest losses are to the tune of 6% in cereals, 8% in pulses, 10% in oilseeds and 15% in fruits and vegetables. The estimated annual value of total losses is about Rs 1 lakh crore<sup>5</sup>. Further, every wasted ton of fruit and vegetable decomposes into approximately 1.5 tons of greenhouse gases (GHG)<sup>6</sup>.

The absence of suitable cooling and refrigeration technologies also limits access to proper healthcare facilities such as medicines and vaccines in public health centres. The immunisation technical support unit, Ministry of Health and Family Welfare, reports 25% vaccine losses in India due to inadequate cold chain infrastructure, even before vaccines reach doctors and patients.

**Annual Value  
of Post-harvest  
Losses**

**1.02  
Lakh Crores**

**Post-harvest  
Produce Loss in  
India**

**15%** Loss in Fruit and Vegetable

**10%** Loss in Oil Seeds

**8%** Loss in Pulses

**6%** Loss in Cereals

*Source: ICAR-CIPHET Annual Report 2018-2019*

<sup>1</sup> European NGOs of Concern Worldwide and Welthungerhilfe, "India - Global Hunger Index (GHI)," 2021, <https://www.globalhungerindex.org/india.html>.

<sup>2</sup> Economist Impact, "India: Global Food Security (GFS) Index 2021," 2021, <https://impact.economist.com/sustainability/project/food-security-index/Country/Details#India>.

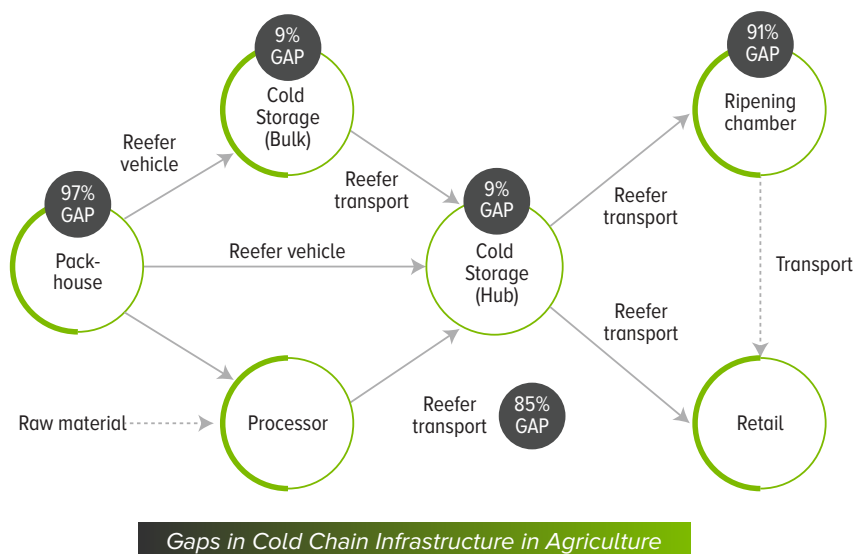
<sup>3</sup> Cooperation & Farmers' Welfare Department of Agriculture, Ministry of Agriculture & Farmers' Welfare, and Government of India, "Annual Report 2020-21," 2021, [https://agricoop.nic.in/sites/default/files/Web copy of AR %28Eng%29\\_7.pdf](https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20Eng%2029_7.pdf).

<sup>4</sup> Government of India. Ministry of Agriculture & Farmers Welfare, "Agriculture Census 2015-16 (Phase-1): All India Report on Number and Area of Operational Holdings," 2019, [https://agcensus.nic.in/document/agcen1516/T1\\_ac\\_2015\\_16.pdf](https://agcensus.nic.in/document/agcen1516/T1_ac_2015_16.pdf).

<sup>5</sup> ICAR-Central Institute of Post-Harvest Engineering & Technology, "Annual Report 2018-19," 2019, [https://www.ciphet.in/upload/files/CIPHET AR 2018-19.pdf](https://www.ciphet.in/upload/files/CIPHET_AR_2018-19.pdf).

<sup>6</sup> Kohli Pawanexh, "Stop Food Loss To Stop Climate Change," 2016, [https://www.researchgate.net/publication/341609223\\_Stop\\_Food\\_Loss\\_To\\_Stop\\_Climate\\_Change](https://www.researchgate.net/publication/341609223_Stop_Food_Loss_To_Stop_Climate_Change).

The India Cooling Action Plan (ICAP) 2019 highlights huge gaps in cold chain infrastructure: Pack-house (97%) followed by ripening chamber (91%), reefer transport (85%), cold storage (9%). These gaps at each link of the cold chain present an opportunity to integrate climate-friendly,



sustainable and energy-efficient technologies in new and upcoming cold chain infrastructure. An energy-efficient cold chain, as per ICAP 2019, has an energy saving potential of around 30% and would reduce the refrigerant demand by 11% from business as usual. An energy-efficient cold chain is crucial for off-grid and weak-grid rural areas and will significantly contribute towards mitigating climate change.

The need of the hour, therefore, is the successful development of cold chain infrastructure through implementation of robust policies and regulations to ensure that energy efficiency and clean energy are an integral part of new and upcoming cold chain infrastructure, along with easy access to finance for farmers, Farmer Producer Organisations (FPO), Farmer Producer Companies (FPC) and other users in the cold chain sector.

## ABOUT THE PROJECT

The project is envisioned to act as a catalyst to reduce food loss by advancing the development and implementation of efficient cold chain infrastructure, thereby supporting the Government of India's fundamental goal of doubling farmers' income. It also fosters the implementation of ICAP 2019 recommendations associated with energy-efficient refrigeration technologies by promoting and adopting low cost refrigeration technologies; providing capacity building and training to technicians, farmers and other stakeholders who will be end-users or will operate the deployed technology.

## PROJECT GOALS, OBJECTIVES AND OUTCOMES

The **project objectives** are centered around the use of energy-efficient cooling and refrigeration solutions/technology for off-grid and weak-grid rural communities to:

- ▶ Reduce food loss through the uptake of agricultural applications such as pre-cooling, staging cold room, cold storage
- ▶ Provide cold storage facilities in rural health centres
- ▶ Build additional income opportunities for rural productive businesses

The **expected long-term outcomes** of the project will be:

- ▶ Increased availability and access to low cost, low energy cooling & refrigeration solutions/ technologies for off-grid/weak-grid rural communities
- ▶ Increased interest from manufacturers for meeting the cooling & refrigeration demand in off-grid/weak-grid rural communities
- ▶ Programmes/action plans for replicating and scaling up well designed, low cost, low energy cooling & refrigeration technologies for off-grid/weak-grid rural communities
- ▶ Increased consumer awareness and labour capacity towards low cost, low energy cooling & refrigeration solutions for off-grid/weak-grid rural communities

Improved food security



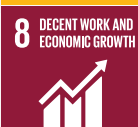
Access to better health services



Addressing climate change



Increasing farmers' incomes



Addressing climate change



*Project Goals*

## KEY STAKEHOLDERS

SFAC, National Horticulture Board, APEDA, MoA&FW, MoRD, District Horticulture Department, NABARD, Krishi Vigyan Kendra etc provide support to horticulture farmers with various government schemes and subsidies

MoH&FW, State health departments, extend health and medical support to rural communities through PHCs

Technology providers and Field experts

Grassroot organizations like NGOs, SHGs, Resource Institutions supporting community based organisaion, Rural Banks



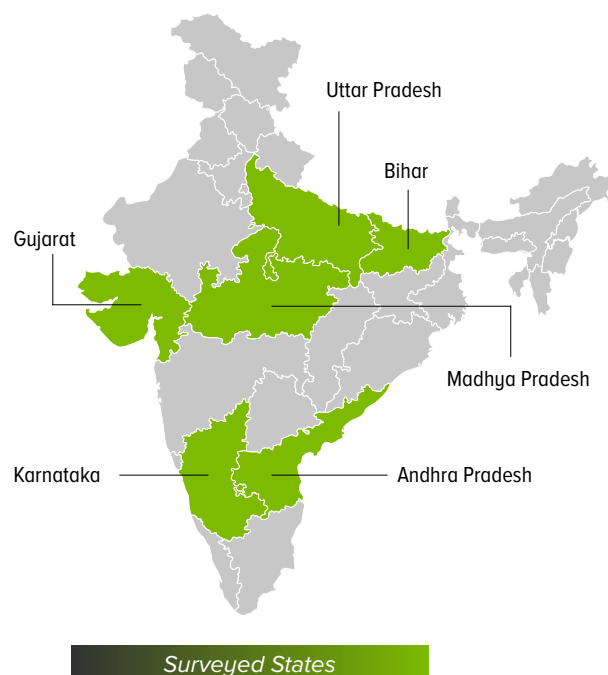
## KEY ACTIVITIES

- 1 Need assessment for cooling & refrigeration technologies
- 2 Evidence-based approach for monitoring and deployment of cooling solutions
- 3 Policy and regulatory recommendations
- 4 Awareness and skill development

1. **Need assessment for cooling & refrigeration technologies in agriculture and healthcare:** Post analysing data collected through primary and secondary sources and inputs received from stakeholder consultations, six states, namely— **Andhra Pradesh** and **Karnataka** (South India), **Madhya Pradesh** and **Uttar Pradesh** (Central & North India), **Bihar** (East) and **Gujarat** (West) were short-listed for the need assessment of cooling & refrigeration technologies in rural India.

The need assessment was conducted in four districts in each state as mentioned below.

State	Districts
Andhra Pradesh	Anantapur, Chittoor, Krishna, Kurnool
Karnataka	Bengaluru Rural, Belagavi, Chikkaballapur, Tumkur
Madhya Pradesh	Chhindwara, Dhar, Katni, Shajapur (Agar)
Uttar Pradesh	Bulandshahr, Muzaffarnagar, Unnao, Varanasi
Bihar	East Champaran, Muzaffarpur, Samastipur, Vaishali
Gujarat	Anand, Bhavnagar, Gir Somnath, Navsari



Within these states, AEEE and its partners identified 60 FPOs/FPCs whose members cultivate horticultural produce, of which 22 FPOs/FPCs were surveyed to assess the potential for cooling solutions to improve FPC and farmer incomes. Following the survey, AEEE shortlisted 7 FPCs in Bihar, Gujarat and Karnataka for a field visit to further develop use cases for cooling solutions. Finally, 3 FPCs in Bihar, Gujarat and Karnataka have been selected to demonstrate energy-efficient cooling solutions for agriculture.

For rural healthcare, AEEE is in the process of identifying use cases for cooling solutions.



2. **An evidence-based approach for monitoring and deployment of cooling & refrigeration technology/solutions:** AEEE consulted with several technology providers engaged in providing cold chain solutions for horticulture, floriculture, dairy, seafood and pharmaceutical sectors, to understand and map low cost and low

energy cooling & refrigeration technologies available in the market for rural India. The table below lists some of these companies and their products. The AEEE team is working with vendors to select appropriate energy-efficient cold chain solutions for technology demonstration in the chosen FPCs.

*Select Technology Providers: Brief Information*

State	Products
Bharat Refrigeration	Cold rooms, Condensing unit evaporators, Solar cold rooms
Bluestar	Condensing and evaporator units, Banana ripening chambers, Modular cold rooms
Carrier India	Modular cold rooms, Supermarket refrigeration products, Condensing units, Evaporators
Cool Crop	Cold storage solutions, Predictive market analysis, Crop management system
Ecozen	Ecotron, Ecofrost, Eco Connect
Inficold	Solar instant milk cooler, Solar bulk milk cooler, Solar cold storage, Data logger for bulk milk cooling, Infilog - remote monitoring system
New Leaf Dynamics	GreenChill cold rooms
PLUSS	ThermoTabActive (PCM-based solution for cold rooms and trucks), Solar cold rooms, Chest freezers
Promethean Power System	Micro chiller, Rapid milk chillers, Conventional milk chiller, Promethean reefer, cold storage solutions
RINAC India	Ripening chambers, Cold rooms, Pre-coolers, Refrigerated trucks, Insulated panels, Roof panels, Chillers, Freezers
Tan 90	Cold storage solutions - Box90, P90, Bag90, Evap90
TESSOL	Cold storage solutions - Active zen box, Passive zen box, Full vehicle solution
Trufrost	Cold rooms, Condensing units, Evaporator units, Pre-coolers
Voltas	Deep freezers, Chest freezers, Combo coolers, Cold rooms

3. **Policy and regulatory recommendations:** AEEE will propose policy and regulatory recommendations at the state and central level to replicate and scale-up low cost and low energy cooling & refrigeration technologies for off-grid/weak-grid rural communities. The team has started mapping out national and sub-national policies and schemes related to cold chain and post-harvest management of produce.

4. **Awareness and skill development:** AEEE has already started sensitising key stakeholders such as FPCs about the need for cooling solutions for preserving the produce and reducing post-harvest food loss while undertaking need assessment and field visits in the agriculture sector at the grassroots level. Awareness and skill development workshops will be conducted during deployment of low cost and low energy cooling & refrigeration solutions in select states.

## ABOUT AEEE

Alliance for an Energy Efficient Economy (AEEE) supports policy implementation and enables the energy efficiency market with a not-for-profit motive. AEEE promotes energy efficiency as a resource and collaborates with industry and government to transform the market for energy-efficient products and services, thereby contributing toward meeting India's goals on energy security, clean energy, and climate change. AEEE collaborates with diverse stakeholders such as policymakers, government officials, business and industry, consumers, researchers, and civil society organisations. We believe that our work speaks for itself and we hold Respect, Integrity, and Synergy as central to our efforts.