

GLOBAL STUDENT POSTER DESIGN COMPETITION 2025

SMART SOLAR COLD CHAINS: INTEGRATING AI WITH FOOD LOGISTICS



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Introduction

India, one of the largest producers of fruits and vegetables, ironically loses over 30% of its produce due to inadequate storage infrastructure.

Among the most devastating consequences is the emotional and financial toll on small and marginal farmers—many of whom are driven to suicide not because of poor harvests, but due to the lack of cold storage to preserve their hard-earned yields.



Smart Cold Storage for Tomatoes (1 cubic meter)



More Income, Less Waste. Even on Small Farms.

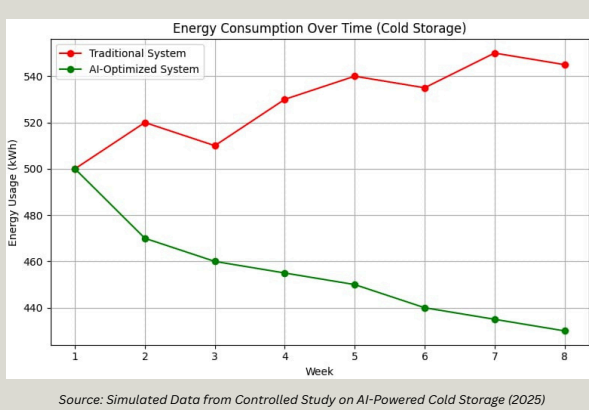
- ✓ Cold storage for marginal farmers
- ✓ Preserves freshness, reduces losses
- ✓ Sell when prices are high, not just at harvest!
- ✓ Works even on land under 1 acre

Smart storage = better profits.

Your harvest. Your control.

20% SMARTER COOLING = ₹350/YEAR SAVED + 1 HOUR MORE BATTERY BACKUP DAILY

20% Smarter Cooling — Powered by AI, Backed by Solar
This graph shows how AI-driven cold storage cuts energy use by up to 20%, saving ₹350/year and adding 1 extra hour of battery backup daily. While traditional systems waste power on fixed cycles, AI learns from load, temperature, and humidity — cooling only when needed. Perfect for marginal farmers, this means lower costs, longer crop life, and sustainable storage anywhere, anytime.



"20% More Cooler + 100% Smarter = AI Solar Intelligence"

Over 112,000 Suicides in India's Farming Industry in 10 Years



In 2022 alone, 11,290 suicides were reported among people involved in agriculture—amounting to one death every hour (NCRB, via DownToEarth, 2023). A significant portion of these are linked to post-harvest losses, market crashes, and crop spoilage due to the absence of affordable and accessible storage (Financial Express, 2014, Indian Express, 2022).

India currently faces a 12.6 million-ton cold storage shortfall, and over 69% of marginal farmers have no storage facility within a 10 km radius (Gaon Connection, 2022, The Week, 2024).

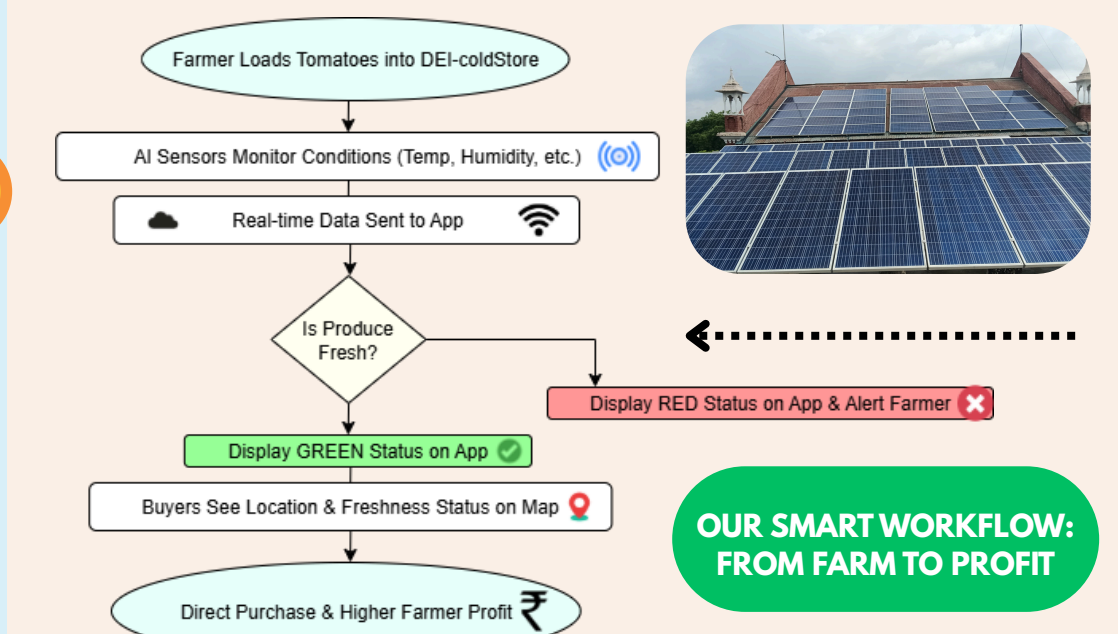
In districts like Burdwan, West Bengal, recurring incidents of potato farmer suicides have been reported—directly tied to rotted crops due to lack of cold chain access (Indian Express, 2022). These are not isolated tragedies, but the echoes of a broken system where technology and infrastructure have failed the very hands that feed the nation.

Marginal Farmer (Shared Use of 1 Cubic Meter Cold Storage)

BUDGET ALLOTTED

Item	Value
1. Storage Size	1m ³ (575 kg total)
2. Shared By	5 Marginal Farmers
3. Investment per Farmer	Rs. 9,200
4. Net Profit per Load	Rs. 835
5. Loads per Month	6
6. Monthly Profit	Rs. 5,010
7. Annual Profit	Rs. 60,120
8. Playback Time	55 days
9. Power Set Up	250W Solar + 50Ah Battery

No.	Component	Specs	Cost (₹)
1	Insulated Cold Box (PUF)	1 m ³ , food-grade	₹10,000
2	DC Cooling Unit	100W, low-watt compressor	₹12,000
3	Solar Panel	250W, 12V	₹8,500
4	Charge Controller (MPPT)	20A, 12V	₹1,500
5	Battery (Li-ion)	12V, 50Ah = 600Wh	₹7,000
6	Microcontroller (ESP32)	Controls logic, BLE, sensors	₹1,500
7	Sensors (Temp, Humidity)	DHT22 or BME688	₹1,500
8	Bluetooth Module + App Setup	Basic integration with ESP32	₹1,000
9	Wiring, Fans, Housing, Frame	Stabilizers, fan, cabling	₹3,000



TRACK. SELL. EARN MORE.
Smart App for Farmers & Buyers
Farmer loads tomatoes into AI Cold Storage
Sensors track freshness, quantity & location
App shows live availability to local buyers
Buyers get directions → buy directly
Farmer earns more, no middlemen!
Fresh Produce. Faster Sales. Bigger Profits.
Your crop. Your app. Your control.



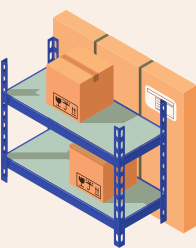
"Every hour, a farmer dies in India — not from drought, but from despair due to post-harvest losses."

Waste Less, Earn More with Cold Storage!

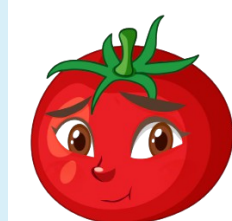
Cold storage is a powerful tool for efficiency and prosperity. By maintaining a precise, low temperature, it dramatically slows down the decay of perishable goods like fruits, vegetables, and dairy product

Why is it beneficial?

It slashes post-harvest losses, ensuring the food we grow reaches the table. For farmers, this means no more forced sales at low prices during market gluts; they can store their produce and sell when the price is right, boosting their income. For consumers, it guarantees a year-round supply of high-quality, safe food. Cold storage is essential for food security.



From ₹5 to ₹29: A Tomato Farmer's Reality in Agra



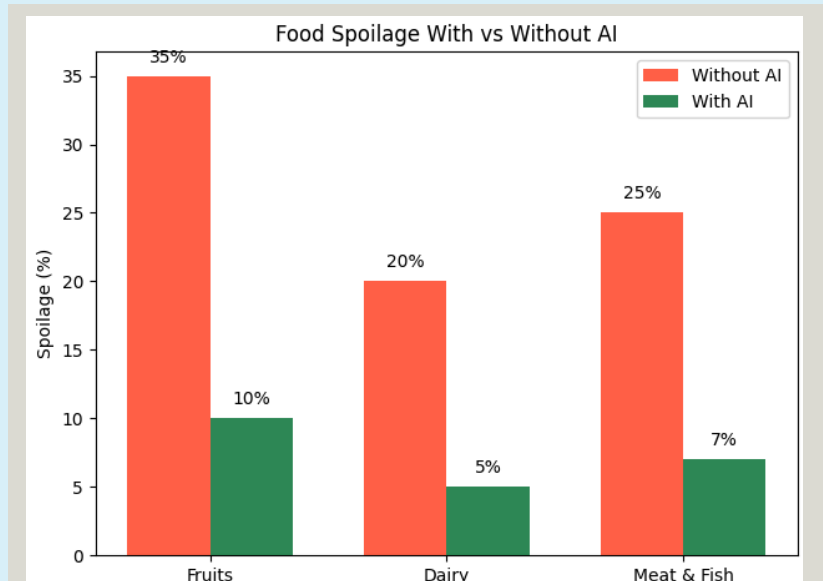
To make me more valuable, store me in cold!

For Agra's marginal tomato farmers, this season presents a stark choice. Without cold storage, the current market glut forces them into distress sales at the local mandi for a rock-bottom price of approximately ₹2-₹5 per kg. This results in crippling losses, with over 20% of their crop often lost to spoilage before it can even be sold.

However, access to a cold storage facility changes everything. By storing their produce for a few weeks, farmers can bypass the price crash and sell when the market stabilizes, fetching a much healthier rate of ₹30-₹38 per kg. This vital infrastructure turns a devastating loss into a sustainable profit.

Resources:

- National Bank for Agriculture and Rural Development (NABARD) Reports
- Ministry of Food Processing Industries (MoFPI) Post-Harvest Loss Data



Our system employs advanced sensors that continuously track temperature and humidity. An intelligent control unit analyzes this data, learning the optimal conditions for your produce. It proactively adjusts the internal climate to prevent spoilage and optimizes cooling cycles, running only when necessary to drastically cut power consumption and extend freshness.

"Empowering farmers: Direct market access and real-time cold storage data."
Scan to learn more.



<https://muditvij.github.io/refcold/>

