Portable and Mobile Forced-Air Evaporative Cooling Chambers for Smallholder Farmers and Produce Vendors

Postharvest losses of fruits and vegetables in low-income, hot, dry regions often reach 30–50%, driven largely by a lack of affordable and effective pre-cooling and storage options. In Nigeria, an estimated 40% of fruits and vegetables are lost after harvest, with tomato losses reaching 76%. In India, farmers and vendors routinely lose 20–35% of produce during the hot season. Pre-cooling—rapidly removing field heat immediately after harvest—and providing a cool, humid storage environment can dramatically extend the shelf-life of many fruits and vegetables, yet most smallholder farmers and vendors lack access to such cold-chain infrastructure.

Forced-air evaporative cooling chambers provide a low-cost, practical storage solution using simple, locally available materials. CoolVeg's innovative design costs far less than refrigerated cold rooms while significantly outperforming non-climate-controlled storage. By enabling farmers and vendors to rapidly cool produce at critical early stages of the supply chain, these chambers help reduce food loss, provide greater flexibility in market timing, and improve community access to fresh, nutritious foods. In hot, dry regions—where produce spoils quickly and water evaporates rapidly—this technology delivers its greatest benefits by providing efficient, natural cooling.

With support from the Efficiency for Access Research and Development Fund, the CoolVeg team developed several versions of these chambers were constructed, tested, and deployed in collaboration with Artisana in India and ColdHubs in Nigeria, including:

- Portable chambers for use in stationary applications
- Mobile chambers for use in transportation applications

Left: Portable cooling chamber with a 20-crate capacity (~400 kg of produce) in Bhuj, Gujarat, India. The evaporative cooler is visible in the upper right of the image. Right: Vendors loading produce into a trailer-mounted mobile cooling chamber in Zaria, Kaduna, Nigeria. The chamber has a 32-crate capacity (~640 kg of produce).

CoolVeg's forced-air evaporative cooling chambers cool 500 kg of vegetables by 10 °C in under six hours while using less than 200 watts—making them nearly ten times more energy-efficient than room-cooling air conditioners. Their rapid cooling capability creates significant value at the pre-cooling stage, especially because the chambers can be deployed directly at the farm gate, reaching produce shortly after harvest.

Built from low-cost materials and powered by highly efficient evaporative coolers, CoolVeg's off-grid systems cost about 60% less than refrigeration-based cold rooms of similar size and are far easier to maintain. These advantages make forced-air evaporative cooling a practical and affordable way to meet unmet pre-cooling and storage needs in low-income regions. The portable version of the chamber is lightweight and can be easily carried by several people and lifted onto a small truck for transportation to remote locations. The mobile version provides cooling during transport, filling a critical gap in cold chains and helping reduce food loss for farmers who lack conventional storage options.

In Nigeria, the shelf-life of many vegetables – including tomatoes, peppers, cucumbers, cabbage, green onions, green beans, and okra – was extended by 4 or more days, lasting up to three times longer in the chamber than in ambient conditions. Red onions performed exceptionally well, with the shelf-life increasing from 14 days outside the chamber to more than 100 days in the chamber.

Above: The shelf-life of tomatoes, bell peppers, cucumbers, and okra stored in the forced-air evaporative cooling chamber and outside of the chamber in the shade. The degradation of the samples stored in the shade is clearly visible, while the samples stored in the chamber are still fresh and edible and salable after 6 days.

This solution delivers important environmental benefits: it avoids hazardous refrigerants, reduces energy use, and lowers net water consumption across the produce value chain. Storing water-intensive crops such as leafy greens or tomatoes in a forced-air evaporative cooling chamber for a week uses less than 1% of the water needed to grow them. By preventing food loss, the chambers significantly reduce overall water demand.

While these cooling chambers offer significant value to farmers and vendors and cost far less than refrigerated cold rooms, many users will still require financing to cover the up-front investment, especially in areas where an off-grid power system is needed. User research indicates that most farmers and vendors can recover the cost of the chamber, installation, and maintenance within 2–3 years. Farmers and retailers who currently rent space in centralized cold rooms expressed a strong preference for owning their own chamber—highlighting a clear demand for accessible financing and scalable deployment models.

Dhavalbhai Jawaharlal Gaur being interviewed by Gulal Bhavsar (Artisana) at his retail vegetable shop in Bhuj, Gujarat, India.

CoolVeg is working with our existing partners in India and Nigeria to commercialize the portable chambers in the respective markets. As an open-source technology, CoolVeg will also look for commercialization partners in suitable markets, including the African Sahel, East Africa, the Middle East, and South Asia.

CoolVeg's innovative forced-air evaporative cooling chambers offer a practical, energy-efficient, and affordable solution to the persistent challenge of postharvest losses in hot, dry regions. By providing rapid cooling and extending the shelf-life of fruits and vegetables, they help farmers protect more of what they harvest. Built from locally available materials and deployable in both portable and mobile forms, these chambers reach farmers where cooling is needed most—at the farm gate, in markets, and during transport. The result is meaningful: reduced food loss, higher farmer incomes, improved food security, and reduced environmental impacts. Investment in this technology directly improves community resilience across vulnerable food systems.

The full report from this project and design documentation for the portable and mobile cooling chambers can be found at: https://www.coolveg.org/cooling-chambers/portable-and-mobile

Contact, Eric Verploegen, CoolVeg Founder: eric@coolveg.org