

Technological Advances to Minimize Post-Harvest Losses in Agriculture

*Sajjan G¹, D Hemanth² and Harshitha K³

¹PhD scholar Department of Agronomy, College of Agriculture, Dharwad

²PhD scholar Department of Agronomy, S. V. Agricultural College, Tirupati

³M.Sc. (Agri.), Department of Agronomy, College of Agriculture, V. C. Farm, Mandya

*Corresponding Author's email: sajjanguru123@gmail.com

India, as a predominantly agrarian economy with a population exceeding 1.42 billion, faces significant challenges in ensuring food security due to extensive post-harvest losses (PHL). Despite record foodgrain production (3539.98 LMT in 2025), approximately one-third of food is lost globally before consumption, translating to not only nutritional deficits but also environmental stress and economic loss. Unlike pre-harvest challenges that are often visible and widely addressed, post-harvest losses are more subtle yet equally damaging, silently eroding the quantity, quality and economic value of agricultural produce. Post-harvest losses in India range from 6.3-13.4% across crops, influenced by inefficient harvesting, drying, processing, packaging and storage. Hence, technological interventions across the post-harvest chain are crucial and can bridge the gap between production and consumption. Scientific studies have shown the superiority of post-harvest technologies (like solar bubble dryers, reversible air flow dryers, hermetic storage, nanopackaging, use of AI and IoT in reducing losses, improving milling yields and preserving nutritional quality). The integration of these findings into practical solutions is essential for reducing PHL and supporting food and economic security.

Post harvest losses- “quantitative and qualitative loss of food in various post harvest operation”.

Types of losses

Quantitative loss: Quantitative loss is a loss in terms of physical substance, meaning a reduction in weight and volume and can be assessed and measured.

Qualitative loss: Quality losses include those that affect the nutrient/caloric composition, the acceptability and the edibility of a given product.

Causes of Post - Harvest Losses

- **Biological:** pests, rodents, microbes
- **Environmental:** relative humidity, temperature extremes
- **Mechanical:** physical damage during handling, transport, etc
- **Managerial:** carrying inefficient practices, marketing delays

Importance of reducing post harvest losses

Food security: It is estimated that 1.3 billion tonnes of food is lost every year, so reducing these losses can feed billions of people without increasing production (FAO, 2011).

Farmer's Income and Livelihoods: Reducing post harvest losses can improve farmer incomes by 15-20 % (CACP, 2020).

Ending hunger, Ensuring nutrition: Reducing Global Hunger and Malnutrition.

Supports Sustainable Agriculture: Helps to achieve Sustainable Development Goals (esp. Goal 12.3 - halving food loss by 2030).

Cost reduction: Improves national food availability without expanding cultivation or inputs. (India loses nearly ₹ 92,651 crores annually due to post harvest losses, ICAR-CIPHET, 2015).

Price stability: Helps in stabilising market prices, reducing distress sales by farmers.

Table 1: Post-harvest losses of major crops and commodities

Crops/ Commodities	Loss (%)	
	ICAR-CIPHET Study 2105	NABCONS study (2022)
Cereals	4.65 - 5.99	3.89-5.92
Pulses	6.39 - 8.41	5.65-6.74
Oil Seeds	3.08 - 9.96	2.87-7.51
Fruits	6.70-15.88	6.02-15.05
Vegetables	4.58-12.44	4.87-11.61
Plantation Crops & Spices	1.18-7.89	1.29-7.33

Note: CIPHET: Central Institute of Post Harvest Engineering, Ludhiana

NABCONS: NABARD Consultancy Services, New Delhi

Post harvest technology

Post harvest technologies constitute an interdisciplinary science and techniques applied to agricultural commodities after harvest for the purpose of preservation, conservation, quality control, processing, packaging, storage, distribution, marketing and utilization to meet the food and nutritional requirements of consumers in relation to their needs.

Why Technological Interventions?

- ☐ Reduce Post-Harvest Losses
- ☐ Enhance Product Quality
- ☐ Increase Farmer Income
- ☐ Improve Efficiency and Labor Productivity
- ☐ Enhance Food Security and Supply Chain Stability
- ☐ Support Sustainable Practices
- ☐ Ensure Traceability and Compliance
- ☐ Improve Packaging and Marketability

Pre-harvest and harvest practices in reducing Post harvest losses

Threshing: Threshing is the process of separating the edible grain from the stalks and husks after harvesting. Technologies include: Pulse specific threshers, multi crop threshers, multi millet thresher, etc

Winnowing: Winnowing follows threshing and involves separating lighter chaff from heavier grains using wind or air. Technologies include: Integrated suction winnowers, Pedal/Wind operated Cleaners, etc

Drying: It is the process of removal of moisture from grains and other products to a predetermined level to provide safe level to store the grain for longer time period.

Safe moisture level- Cereals: 12-15% (wet basis)

Pulses: 7-10% (wet basis)

Oilseeds: 7-9% (wet basis)

Drying Technologies

Solar Bubble Dryer: The Solar Bubble Dryer (SBD) is the latest low-cost drying technology developed by IRRI, Hohenheim University and GrainPro.

- The SBD is mobile and is completely independent from fuel or the power grid, and therefore has very low operating cost.
- Solar Tunnel Dryer: Designed and developed under AICRP on PHT, Raichur

- Desired drying temperature of 50 °C - 55 °C can be achieved in drying chamber

Purdue Improved Crop Storage (PICS) bags:

- PICS bags are a three-layer, hermetic bag-system
- It is a method of using sealed, airtight units to control moisture and insects in stored dry agricultural commodities.
- Air tight storage
- Creates automatic modified atmosphere of high CO₂ concentration

Metal Silos

- Metal silos are airtight, cylindrical storage structures made of galvanized steel or aluminum, used to store grains and seeds safely over long periods.
- Designed to protect stored grain from moisture, insects, rodents, and mold.
- Capacity : 0.5 to more than 100 tons (small to industrial scale)
- Reduced losses up to 30%.

Modified Atmospheric Packaging (MAP)

- The unit is designed for MAP, a food packaging technology that extends the shelf life by altering the composition of internal gas (reducing O₂, CO₂ or N₂ concentration)
- Helps to slow down the microbial growth and oxidation.

Features:

Portable CO₂ unit: used to flush the atmosphere inside the package.

Nanopackaging

- Nano packaging is an advanced food packaging technique that uses nanomaterials improving their ability to protect and preserve agricultural produce.
- Nanomaterials used include:
- Silver nanoparticles – antimicrobial
- Zinc oxide nanoparticles – UV-blocking and antimicrobial

Edible coating

- **Edible coatings** are thin, biodegradable layers applied directly onto the surface of fruits, vegetables or other produce to extend shelf life, maintain quality and reduce post-harvest losses.
- Eg: Aloe vera gel, gum arabic, whey protein, Chitosan, casein, beeswax, pectin, edible oils (castor, sunflower), alginate, starch
- CFTRI mini dhal mill
- The CFTRI Mini Dhal Mill developed by the Central Food Technological Research Institute (CFTRI), Mysuru, India.
- It is designed to reduce post-harvest losses (PHL) in pulse processing

Double Chamber Centrifugal De-Huller for millets

- 10% more recovery (since the bran is retained in the kernel)
- Suitable for little millet, proso millet, foxtail millet, barnyard millet and kodo millet.
- The capacity of the de-huller is 300 kg of per hour.
- The efficiency of the unit is 95%

Storage and Transportation Technology

Radio Frequency Identification used for tracking grain bags and storage conditions

- ❑ RFID can be used in
- Tracking grain bags
- warehouse monitoring
- Transport logistics
- Cold chain monitoring
- Packaging with RFID

Government Policies

- **Agri Infrastructure Fund:** Purpose: to reduce PH-losses, improve storage and marketing facilities.

- **Infrastructure covered:** Warehouses, cold storage, grading and sorting units, silos, supply chain and logistics facilities.
- **PMKSY:** Pradhan Mantri Kisan Sampada Yojana (PMKSY) by the Ministry of Food Processing Industries (MoFPI) is implemented with the objective of reducing post-harvest losses of horticulture and non-horticulture produce and providing remunerative price to farmers for their produce.
- **PMFME:** PM formalisation of micro food processing enterprises scheme
- Prodes financial, technical and business support to micro food processing units.

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