

Post-Harvest Loss and Management in Fruit Crops: A Comprehensive Exploration of Causes and Solutions

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Introduction:

Post-harvest refers to the period of time after agricultural crops, including fruits, vegetables, and grains, have been harvested from the field. This phase involves a series of activities and processes aimed at preserving, handling, and preparing the harvested produce for storage, distribution, and consumption. The primary objectives of post-harvest management are to minimize losses in quantity and quality, maintain the nutritional value of the produce, and ensure its safe and timely delivery to consumers. Post-harvest loss (PHL) refers to the reduction in quantity and quality of agricultural produce that occurs after harvest and before consumption. In the case of fruit crops, PHL is a significant challenge that affects farmers, consumers, and the overall economy. Efficient post-harvest management is crucial to minimize losses, enhance food security, and improve the livelihoods of farmers. This article explores the causes of post-harvest loss in fruit crops and discusses various strategies for effective management. Post-harvest activities encompass a wide range of tasks, including sorting, cleaning, grading, packing, transportation, storage, and processing. The ultimate goal is to extend the shelf life of the harvested crops, preventing spoilage, decay, and other forms of deterioration. Effective post-harvest management is crucial for sustaining the economic viability of agricultural production, reducing food waste, and ensuring a stable and secure food supply chain. The specific methods and technologies employed in post-harvest management vary depending on the type of crop and local conditions.

Advantages of Post-Harvest Management:

- 1. Reduced Losses:** Proper post-harvest technology and management helps minimize losses in quantity and quality, ensuring that a larger proportion of the harvested produce reaches consumers in a marketable condition.
- 2. Extended Shelf Life:** Effective post-harvest practices and by using proper methods of preservations such as preservation by high temperature (Pasteurization, Sterilization), low

temperature, chemical preservatives, fermentation, carbonation, irradiation, antibiotics, refrigeration, controlled atmosphere storage, and appropriate packaging like waxing, vacuum packaging (VP), seal packaging, polyethylene and polypropylene bags, polyvinylchloride (PVC), polypropylene (PP), polyethylene (PE) contribute to extending the shelf life of fruits, vegetables, and grains.

3. **Improved Marketability:** Sorting, cleaning, and grading during post-harvest processing enhance the overall appearance and quality of the produce, making it more appealing to consumers and improving marketability.
4. **Enhanced Nutritional Value:** Proper handling and storage conditions help maintain the nutritional content of fresh produce, ensuring that consumers receive fruits and vegetables with maximum health benefits.
5. **Increased Profitability:** By reducing post-harvest losses, farmers and stakeholders in the supply chain can enhance overall profitability. More marketable produce and longer shelf life contribute to increased revenue.
6. **Market Access:** Meeting quality and safety standards through effective post-harvest management facilitates access to broader markets, including domestic and international markets, expanding opportunities for farmers.
7. **Job Creation:** Post-harvest activities, such as sorting, packing, and transportation, create employment opportunities, especially in rural areas where agricultural production is a significant economic activity.
8. **Sustainable Agriculture:** Sustainable post-harvest practices contribute to the overall sustainability of agriculture by reducing waste, conserving resources, and promoting environmentally friendly technologies.
9. **Reduction in cost of production:** Post harvest technology reduces cost of production, packaging, storage, transportation, marketing and distribution etc. It lowers the price for consumer and increases the farmer's income.
10. **Reducing malnutrition:** It ensures availability of sufficient food to feed the ever-growing population thus reducing malnutrition and ensuring healthy growth of the nation.
11. **Availability (Temporal and Spatial):** Availability of fruits and vegetables in off-season and throughout India is possible because of post-harvest technology. Ex- Cold storage, processing, export-imports.

- 12. Export earnings:** Export of fresh and processed horticultural commodities earn valuable foreign exchange.
- 13. Defence and astronauts:** Defence forces posted in remote border areas and astronauts who travel into space have special requirement for ready to eat and high energy low volume food. These requirements are fulfilled by processing horticultural produce.
- 14. Infant and sports preparation:** Special infant and sports drinks and other processed preparation are available for use especially by these people. These preparations are done to meet specific nutritional requirement of their body.
- 15. Role of Government** Central and state governments are encouraging fruits and vegetables processing industries through various programs. Subsidies are made available for cold storage, ripening chambers etc, different training programs are conducted to train farmers in processing.

Disadvantages of Post-Harvest Management:

- 1. Initial Investment:** Implementing advanced post-harvest technologies and infrastructure requires a significant initial investment, which can be a challenge for small-scale farmers and resource-constrained regions.
- 2. Technical Expertise:** Some post-harvest technologies require specialized knowledge and skills for proper implementation. Lack of technical expertise may limit the adoption of these practices, particularly in rural areas.
- 3. Energy Consumption:** Certain post-harvest technologies, such as refrigeration and controlled atmosphere storage, rely on energy-intensive processes, leading to increased energy consumption and associated costs.
- 4. Logistical Challenges:** Efficient post-harvest management involves well-organized logistics for transportation and storage. Inadequate infrastructure and transportation systems can pose challenges to effective implementation.
- 5. Environmental Impact:** The use of certain packaging materials and technologies may have environmental consequences, such as increased plastic waste. Balancing the benefits of post-harvest management with environmental sustainability is a consideration.
- 6. Access to Technology:** Limited access to post-harvest technologies, especially in remote or underdeveloped regions, can hinder the adoption of best practices and result in higher post-harvest losses.

7. **Resistance to Change:** Traditional farming communities may be resistant to adopting new post-harvest management practices, leading to a slower rate of technology adoption and implementation.
8. **Market Volatility:** Even with effective post-harvest management, external factors such as market fluctuations, trade policies, and climate events can impact the profitability and success of the agricultural supply chain. While post-harvest management offers numerous advantages, addressing the associated challenges is crucial to ensuring its successful implementation and widespread adoption across diverse agricultural landscapes. Policymakers, researchers, and stakeholders play a vital role in supporting farmers and communities to overcome these challenges and build resilient and sustainable post-harvest systems.

Causes of Post-Harvest Loss in Fruit Crops:

1. **Physical Damage:** Fruits are susceptible to physical injuries during harvesting, poor handling, unsuitable containers, improper packaging and transportation. Bruises, cuts, break, wound and abrasions can compromise the integrity of the fruit, making it more susceptible to microbial attack and decay.
2. **Pathogen Infections:** Bacteria, fungi, insect and viruses can infect fruits, leading to rot and decay. Pathogens thrive in conditions of high humidity, inadequate ventilation, and poor sanitation during handling and storage.
3. **Inadequate Storage Facilities:** Improper storage facilities, such as lack of temperature control, inadequate ventilation, and inappropriate humidity levels, contribute to the acceleration of ripening and deterioration of fruits.
4. **Ethylene Exposure:** Ethylene is a natural plant hormone that promotes ripening. Exposure to ethylene, either from other fruits or environmental sources, can lead to premature ripening and spoilage.
5. **Pest Infestations:** Insects and rodents can damage fruits during storage, leading to both physical and microbial deterioration.
6. **Lack of Post-Harvest Technologies:** Limited access to post-harvest technologies, such as cold storage, controlled atmosphere storage, and ripening chambers, can contribute to increased post-harvest losses.
7. **Developmental:** These include sprouting, rooting, seed germination, which lead to deterioration in quality and nutrition value.

8. **Physiological deterioration:** Fruits and vegetable cells are still alive after harvest and continue their physiological activity. Physiological disorders may occur due to mineral deficiency, low or high temperature injury or undesirable atmospheric conditions, such as high humidity, physiological deterioration can also occur spontaneously by enzymatic action leading to over- ripeness and senescence, a simple aging phenomenon.
9. **Lack of market demand:** Poor planning, inaccurate production and market information may lead to over production of certain fruits or vegetables which can't be sold in time. This situation occurs most frequently in areas where transportation and storage facilities are inadequate. Produce may lie rotting in production areas, if farmers are unable to transport it to people who need it in distant locations.
10. **Consumption:** These losses can be due to inadequate preservation methods at home, method of cooking and preparation such as peeling, consumption styles, etc.
11. **Others:** Lack of clear concept of packing house operations, lack of awareness among the growers, contractors and even the policy makers, lack of infrastructure, inadequate technical support, wide gap in technologies available and in vogue, inadequate post-harvest quality control, unorganized marketing, absence of pre-cooling and cold storage, poor storage facilities.

Post-Harvest Management Strategies:

1. **Harvesting Practices:** Educating farmers on proper harvesting techniques, including the use of sharp tools, gentle handling, and proper timing, can minimize physical damage to fruits.
2. **Sanitation and Hygiene:** Maintaining clean and hygienic conditions during harvesting, handling, and storage helps reduce the risk of microbial contamination and decay.
3. **Storage Facilities:** Investing in proper storage infrastructure, such as cold storage, controlled atmosphere storage (CAS), modified atmosphere storage (CAS), zero energy cool chamber (ZECC), Low pressure storage (LPS)/ Hypobaric storage (HBS) can significantly extend the shelf life of fruits.
4. **Temperature and Humidity Control:** Monitoring and controlling temperature and humidity levels during storage are critical for preserving the freshness and quality of fruits.



5. **Packaging Innovations:** The use of appropriate packaging materials and techniques can protect fruits from physical damage, pest infestations, and environmental factors that contribute to deterioration.
6. **Transportation:** Implementing efficient transportation systems, including proper packaging, refrigerated transport, and reduced transit times, can minimize losses during the transit from farm to market.
7. **Training and Education:** Providing training and educational programs to farmers and stakeholders on best practices in post-harvest management can enhance awareness and adoption of effective techniques.

Conclusion:

Addressing post-harvest loss in fruit crops requires a holistic approach that involves the collaboration of farmers, researchers, policymakers, and the private sector. By implementing efficient post-harvest management strategies, we can not only reduce losses but also ensure a more sustainable and resilient food supply chain, benefiting both producers and consumers. Effective post-harvest management in fruit crops is a multifaceted challenge that requires collaborative efforts from farmers, researchers, policymakers, and the private sector. By addressing the root causes of post-harvest losses and implementing comprehensive management strategies, we can build a more resilient and sustainable fruit supply chain that benefits both producers and consumers. The integration of innovative technologies, ongoing education, and strategic investments in infrastructure are essential components of a successful approach to reducing post-harvest losses in fruit crops.

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