Post-Harvest Management and Value Addition in the North Eastern Hill Region of India

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The North Eastern Hill (NEH) region of India possesses immense potential in horticulture, with fruits, vegetables and spices contributing significantly to the agricultural economy. However, this potential remains underutilized due to high post-harvest losses, challenging infrastructure and inadequate adoption of scientific management practices. Recent studies indicate that post-harvest losses of fruits and vegetables in India range between 30-40%, largely due to poor handling, storage and transportation systems. Globally, losses in fruits and vegetables can reach 25-50% across the supply chain, making it one of the most loss-prone agricultural sectors. Reducing these losses is now recognized as a more sustainable and cost-effective strategy than increasing production, as emphasized in recent FAO policy analysis.

Status and challenges in post-harvest management

NEH region faces severe constraints that contribute to high post-harvest losses due to high perishability of the horticultural produces, lack of cold storage and pack house facilities, poor road connectivity and transport bottlenecks, limited processing infrastructure, weak market intelligence systems. Recent estimates suggest that India incurs economic losses of approximately ₹1.5 trillion annually due to post-harvest inefficiencies. These losses are particularly severe in remote and hilly regions like the NEH, where accessibility and logistics remains to be major challenges.

Scientific basis of post-harvest losses

Post-harvest losses occur at multiple stages viz. harvesting, handling, storage, transportation and marketing. Recent research highlights that mechanical damage, microbial decay and physiological deterioration are primary causes of loss. Supply chain inefficiencies significantly increase wastage in developing regions and losses are highest at early stages (harvest and handling) in low-income regions. Advances in non-destructive technologies and machine learning based shelf-life prediction systems are emerging as innovative tools for reducing losses and improving quality monitoring.

Importance of scientific post-harvest management

Scientific post-harvest management (PHM) practices are essential for reducing quantitative and qualitative losses, extending shelf life, enhancing nutritional and market value, improving farmer income and food security. Therefore, key practices must include viz. harvesting at proper maturity indices, sorting and grading, use of protective coatings and packaging, and controlled storage systems. Recent studies confirm that improved PHM interventions can significantly enhance food availability without increasing production pressure on natural resources.

Opportunities for value addition and secondary agriculture

NEH region has strong potential for value addition and agro-based enterprises, including processing of spices (ginger, turmeric, cinnamon), fruit processing (pineapple, citrus, banana), starch extraction from tuber crops, essential oil production (viz. bay leaf oil rich in eugenol), agro-waste utilization (rice husk, bagasse, cocopeat, vermicompost). Global research on PHM emphasizes valorization of agricultural waste into bio-products, contributing to circular economy and sustainability goals.

Strategies for improving post-harvest management

- Capacity building and technology dissemination - Training farmers in scientific PHM practices, promoting low cost mechanization and strengthening extension systems.
- Infrastructure development - Establishment of pack houses at district level, cold chain and storage development and decentralized processing units.
- Research and innovation - Shelf-life enhancement technologies, packaging innovations for rugged terrains and research on indigenous crops. Emerging innovations include biodegradable coatings, smart

packaging and artificial intelligence (AI) based quality monitoring systems.
- Market intelligence and digital integration - Real-time price and demand forecasting, prevention of distress sales and development of digital agricultural databases.
- Policy and institutional support - Promotion of public private partnerships (PPP), integration of production processing marketing systems and encouragement of agri-entrepreneurship.

Role of agricultural engineering and mechanization

Agricultural engineering plays a critical role in reducing drudgery and improving efficiency and is vital component to tackle the post-harvest losses, emphasizes is required on technology adoption and mechanization which are key drivers of post-harvest loss reduction. Major constraints commonly identified are inadequate mechanization, lack of storage and processing infrastructure, weak policy integration, limited credit access, poor market systems, and difficult terrain and connectivity challenges. Some measures may include -

- Development of region-specific tools and machinery.
- Mechanization of harvesting and post-harvest operations.
- Promotion of renewable energy solutions (viz. briquettes).
- Establishment of local manufacturing units.

Way forward

Future strategies need focus on the development of high value low volume products, strengthening secondary agriculture, infrastructure and logistics improvement, entrepreneurship and private sector participation, integration of research, capacity building of stakeholders particularly horticulture value addition and processing, extension and marketing systems. Reducing post-harvest losses is now central to achieving 'Sustainable Development Goal (SDG) 12.3', which targets halving food loss and waste globally. Market intelligence i.e., intelligence on rise and fall of markets for different commodities, likely demand of crops/commodities in regional, national and global markets, balancing of seed and planting material requirements, etc. need to be gathered in a collaborative mode with state government and other agencies for issuing forewarning to the growers so as to avoid distress sell and booking intelligent profits.

Conclusion

It is understood that post-harvest management and value addition are critical for transforming agriculture in the NEH region into a sustainable market-oriented system. With improved infrastructure, technological interventions, institutional support and farmer's participation, the region can significantly reduce losses, enhance farmer income and contribute to national food security.

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