Vegetables Packinghouse as Strategies to Promote the Best Postharvest Practices and Vegetables Value Chain Business

CE SAIN Lecture Series
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Tong Socheath
Division of Research and Extension
“By 2030, halve per capita global food waste at retail and consumer levels and reduce food losses along production and supply chains, including postharvest losses”
About 33% of total food produced for human consumption is lost or wasted.

~ 1.3 billion tons of food (can feed 2B people); about one trillion USD in economic losses; one-fourth of total freshwater, cropland and fertilizers used in production; and over 3B tons of CO₂ emission/year

About 50% of the losses could be prevented with a more efficient supply chain.

One billion extra people could be fed if food crop losses could be halved.
Vegetables Postharvest Losses (PHL)

Weinberger et al., 2009; Acedo and Easdown, 2014; Gautam et al., 2014; AVRDC-APCTT SATNET Asia 2014
Unseen PHL of Vegetables

• Nutritional loss:
  27–100% Vit C in fresh produce
  15–55% Vit C due to cooking
  15–63% Vit C; 20–60% B1, B6 due to blanching
  10–90% Vit C, 7–70% B1, B6 due to canning
  Most Vit C due to drying

• Food safety loss:
  Microbiological factors (e.g. *Salmonella, E. coli*) – food poisoning, export rejection
  Chemical factors – pesticide residues, toxins (e.g. aflatoxin)

Barrett 2007; Rickman et al 2007
Impact of PHL

- Reduce farmers’ income
- Reduce food availability
- Increase cost of food; negative impact on food access
- Represent a waste of nutrients and food calories
- Perpetuate gender inequality
Crosscutting Strategies to Reduce PHL

- Develop PHL measurement protocol
- Set PHL reduction targets
- Increase investment in PHL reduction in developing countries*
- Support partnerships to reduce PHL

*Between 1990 and the present time, World Bank estimated that of the thousands of development projects in developing countries, only 25% have focused on agriculture; about 1% of these agricultural projects have focused on horticulture; and only one-third of these horticulture projects have a postharvest component.
Postharvest Program in Asia

- **USAID Postharvest**
  - Nepal
  - Bangladesh
  - Cambodia
  - Laos
  - Vietnam
  - India

- **USAID AIP - value chain**
  - Pakistan
  - (Tomato, chili, onion)

- **ADB CLV Postharvest**
  - Vietnam
  - (Tomato, chili, cabbage, kale, mustards)

USAID Postharvest: (Tomato, eggplant, cauliflower, mustard)

Karnataka, Maharashtra and Odisha States – value chains
(Tomato, chili, onion)

SDC CHAIN - processing
(fermented & dehydrated products)
Strategic Approach

Value chain analysis
Quantify losses; determine needs and opportunities for intervention

Technology generation
Adapt available technologies to local situation; develop new technologies

Building capacities
Promote technological and organizational interventions
Value Chain Analysis

Value chain analysis → Technology generation → Building capacities

- Upstream approach
- Value chain maps for priority vegetables
- Postharvest loss and value
- Strategies and priorities for PHL reduction

Surveys → Validating findings and priorities
Value Chain Analysis

Value chain analysis → Technology generation → Building capacities

Postharvest losses

- Due to handling, packaging and storage deficiencies
- Value chain actors not exposed to postharvest technologies
Best Practices and Technologies

Value chain analysis

Technology generation

Building capacities

- Good transport and market handling practices
- Value addition (solar dryers, fermentation, sauces)
- Storage (Coolbot storage; evaporative cooler)
- Packaging (MAP, best practices)
- Sorting/grading and pretreatment techniques (sanitizer/antimicrobials, precooling)
- Good harvesting and field handling practices
- Improved varieties (long shelf life, processing)
Best Practices, e.g. Sorting

**Price, USD**

- Tomato, 100kg: 21 USD (Unsorted), 39 USD (Sorted/graded), 20% Increase
- Chili, 100kg: 21 USD (Unsorted), 67 USD (Sorted/graded), 39% Increase
- Cucumber, 100kg: 21 USD (Unsorted), 64 USD (Sorted/graded), 20% Increase
- Chinese cabbage, 100kg: 21 USD (Unsorted), 50 USD (Sorted/graded), 10% Increase

**Postharvest loss, %**

- Tomato: 40% (Unsorted), 10% (Sorted/graded)
- Chili: 25% (Unsorted), 8% (Sorted/graded)
- Cucumber: 20% (Unsorted), 5% (Sorted/graded)
- Chinese cabbage: 20% (Unsorted), 5% (Sorted/graded)

Acedo 2015; Kitinoja & Barrett, 2015
Technology Development

- From varieties to processing: with prior review of available experience; research planning and execution; communication (training, publications)

Breeding

Crop management

Fresh produce handling

Processing

Variety trials on station/on farm

Quality/shelf life responses to irrigation

Packaging, storage, special treatments

Drying; sauce processing, fermentation
Long Shelf Life & Processing Varieties

- WorldVeg tomato and chili advanced lines selected for good quality, shelf life and processing attributes
## Low-cost Cooling Options

### Technical and economic benefits of evaporative cooling storage

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Weight loss, %</th>
<th>Shelf life, days</th>
<th>Net return, USD/kg (partial budget)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>1-7 (5-23)</td>
<td>12-15 (7-9)</td>
<td>0.24-0.34</td>
</tr>
<tr>
<td>Chili</td>
<td>4-6 (12)</td>
<td>6-8 (3-4)</td>
<td>0.28-0.33</td>
</tr>
<tr>
<td>Eggplant</td>
<td>1 (6)</td>
<td>4 (2)</td>
<td>0.20</td>
</tr>
<tr>
<td>Leaf mustard</td>
<td>3-15 (15-28)</td>
<td>3 (1)</td>
<td>0.14-0.26</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>18 (44)</td>
<td>9 (7)</td>
<td>0.50</td>
</tr>
<tr>
<td>Bitter gourd</td>
<td>2 (6)</td>
<td>5 (2)</td>
<td>0.25</td>
</tr>
<tr>
<td>Cabbage</td>
<td>6-11 (19-22)</td>
<td>14-22 (8-16)</td>
<td>0.19-0.24</td>
</tr>
<tr>
<td>Chinese kale</td>
<td>4 (23)</td>
<td>4 (2)</td>
<td>0.22</td>
</tr>
<tr>
<td>Cucumber</td>
<td>3 (10)</td>
<td>4 (2)</td>
<td>0.18</td>
</tr>
</tbody>
</table>

*Values in parentheses are for ambient storage (control).*
## Modified Atmosphere Packaging

### Technical and economic benefits of modified atmosphere packaging (MAP)

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Weight loss, %</th>
<th>Shelf life, days</th>
<th>Net return, USD/kg (partial budget)</th>
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</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>1-8 (6-20)</td>
<td>15-19 (9)</td>
<td>0.13-0.36</td>
</tr>
<tr>
<td>Chili</td>
<td>0-1 (9-12)</td>
<td>6-9 (3-6)</td>
<td>0.40-0.65</td>
</tr>
<tr>
<td>Eggplant</td>
<td>0-4 (6-22)</td>
<td>4-14 (2-5)</td>
<td>0.20-0.80</td>
</tr>
<tr>
<td>Leaf mustard</td>
<td>1-5 (11-28)</td>
<td>3-4 (1)</td>
<td>0.10-0.35</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>25 (31)</td>
<td>9 (7)</td>
<td>0.10</td>
</tr>
<tr>
<td>Bitter gourd</td>
<td>1 (6)</td>
<td>4 (2)</td>
<td>0.30</td>
</tr>
<tr>
<td>Cabbage</td>
<td>1-5 (19-22)</td>
<td>12-24 (8-14)</td>
<td>0.21-0.48</td>
</tr>
<tr>
<td>Chinese kale</td>
<td>1 (37)</td>
<td>3 (1)</td>
<td>0.32</td>
</tr>
<tr>
<td>Cucumber</td>
<td>0 (10)</td>
<td>4 (2)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

*Values in parentheses are for no MAP (open, control).*
<table>
<thead>
<tr>
<th>Safe Antimicrobials and Processing Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calcinated calcium as novel non-chlorine sanitizer</strong></td>
</tr>
<tr>
<td><strong>Tomato-chili sauce processing</strong></td>
</tr>
<tr>
<td><strong>Simple solar dryers for hygienic drying of chili, cabbage</strong></td>
</tr>
</tbody>
</table>
Building Capacities

Value chain analysis

Technology generation

Building capacities

- Trainings, techno demo, field days, agro-trade fairs, consultations
- Student research
- Farm-packhouse-market models

CA farms for safe vegetables

Coolbot-packhouse

‘Tuktukbot’ for direct retailing
Building Capacities

- Training of trainers (TOT) and technology end-users trainings (TEU)
Farm-Packhouse-Market Model

- Farm-packhouse-market system enables business engagement of small farmers’ groups.
- PACKHOUSE – links farmers with markets; hub for quality assurance, chain coordination and governance.
- Packhouse – also called consolidation or collection center but many collection centers established in developing countries have no **packhouse operations**; only an area for farmers to bring their produce for traders to collect.

Simple packhouse of a smallholder farmers’ cooperative in Cambodia
Training Publications

- Training manuals
- Technology briefs
- Technology posters
Able to buy other assets (land, generator, motorbike, bicycle, home appliances, poultry, farm inputs) (61%)

Opened another business (6%)

Provided employment to family members (6%)

Send children to school (17%)

Save money in the bank (17%)

Higher income (100%)

Impact

Weinberger et al., 2009
Impact

Cambodia

Mr. Popich, a farmer from Kandal province, applied the knowledge obtained from the WorldVeg postharvest training.

Before
Local variety (low market); Proper harvesting and handling not known; No sorting, fruit of mixed quality in a pack; Bamboo basket at 200 kg

1. Price of local variety — 300 Reil/kg
2. PH loss — 10 kg/200 kg basket (5%)
3. Net income — 3-4M Reil/year

(1 USD=4,000 Reil)

After
WorldVeg CLN1462A and cherry tomato (high market); WorldVeg safe production practices; Harvest mature green to breaker fruit at cooler part of day; Avoid exposure to sun; Use containers with smooth surfaces; Sorting; Packing in plastic bag at 20-22 kg; Careful handling

1. Price of CLN1462A — 700 Reil/kg
2. PH loss — avoided (0%)
3. Net income — 6-7M/year Reil
4. Life is easier — enough food and money; bought new motorcycle; improved residential lot; higher contribution to social and civic activities.
Vietnam

Mr. Hanh, a farmer-collector in Nam Dinh Province, used the knowledge from WorldVeg’s postharvest training to diversify into processing and obtained Agribank loan to acquire processing equipment. Produced tomato puree, chili sauce and dried products for domestic and East European markets; employed 100 people and his 5 sons who expanded the business; incomes increased sharply and more assets acquired.
Average PHL of vegetables – 35%

Value of PHL from total vegetable production of 5 million tons valued at $1,726,450,000 (FAOSTAT 2016)

1,750,000 tons = $604 million

Goal: by 2030, reduce PHL by 50% to meet SDG 12.3

PHL varies with crop, location, production season and value chain actor. PHL reduction must be grounded in local conditions and local culture. Value chain specific interventions can be viable approaches.
Dedicated NARES and Opportunities

- Major NARES institutions dedicated (or with dedicated component) to PHL reduction with strong postharvest expertise
  1–BSU; 2–PhilMech & CLSU; 3–PHTRC (UPLB); 4–VSU; 5–CMU; 6–UP Mindanao

- Support systems: DA (BAR, HVCCDP); DOST (PCAARRD); private companies (e.g. CSR component)

- External development partners

- Strong presence of global and national food chains

Some challenges: developing partnerships; tapping funding; increasing markets for vegetables
Possible Netherlands–Philippines Partnerships

- Cold chain technologies and infrastructure, including RFID technologies – can take off from DA-BAR National Cold Chain Program (started in 2004) and USDA Cold Chain Project in Caraga Region (started in 2014)

- Compact farming – 5–20 hectares automated greenhouses with own packhouse and cold chain system for high-value markets

- Upgrading of multi-million peso vegetables/fruit trading posts into Central Consolidation Center with systematic technological and marketing capacities (Thailand experience)

- Modeling of quality management in chain

- Development and mainstreaming of quality/food safety assurance systems
Thank you for your kind attention.