Roadmap Post-Harvest Loss Reduction in Selected Vietnamese Value Chains – Phase 1

Hotspots and feasible interventions in dragon fruit and longan

May 31, 2021

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Roadmap Post-Harvest Loss Reduction in Selected Vietnamese Value Chains – Phase 1: Hotspots and feasible interventions in dragon fruit and longan
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1. Project Framework

Content

• 1.1 Goal, methodology, steps
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• 1.4 Interviews and measurements
1.1 Goal, Methodology and Steps

**Goal**
Reduce Food losses in the Vietnamese fruit and vegetable supply chains by combined efforts of Vietnamese stakeholders and Dutch companies and supported by Dutch knowledge on food losses and waste monitoring and interventions.

**Methodology**
- Literature Research
- Field Visits
- Food Measurements in Dragon Fruit Losses
- In Depth Interviews in Vietnam & The Netherlands

**Steps**
1. Food Losses and Waste Hotspots
2. Feasible Interventions
1.2 Definitions - a

The FAO definitions for Food Loss & Food Waste (FLW) were taken as reference for this project: FLW include the **decrease of quantity or quality of food** resulting from decisions and actions by stakeholders across the value chain.

Within this project, a further distinction is made between:
- physical losses and waste (loss of material resource and/or associated inputs) and
- economic losses: lower economic benefit / higher economic costs
1.2 Definitions - b

Examples of losses include:

- **FOOD LOSSES**
  - Landfill
  - Animal feed
  - Incineration
  - Plagues, rodent/birds

- **ECONOMIC LOSSES**
  - Sold at market for discount prices
  - Sold to food processing
  - Self-consumption
  - Donate to charity

We distinguished between: ‘Real Food Losses and Waste’ and ‘Economic losses’. Both are included in this project.
1.3 Selection of the two most promising supply chains

Context of selection process

▪ Project plan scheduled for 1 or 2 food supply chains (1 domestic, 1 export)

▪ Mekong Delta was agreed upon with the Netherlands Embassy in Hanoi as a selected region (being by far the largest fruit production area in Vietnam, and suitable for export)

▪ Preference of project team was 2 product-region combinations, and during project meeting the two main urban areas are selected: Red River Delta with Hanoi and Mekong Delta close to Ho Chi Minh City.

▪ The products were selected by a multicriteria evaluation process on 14 indicators (unfortunately good data could be found for 6 indicators only; especially the lack of information on food loss and waste made the choice more difficult)
1.3 Selection of the 2 most promising supply chains

Red River Delta

<table>
<thead>
<tr>
<th>ID</th>
<th>Product supply chain</th>
<th>Production trend (increase)</th>
<th>Production areas (size)</th>
<th>Export (size in weight)</th>
<th>Import (dependency)</th>
<th>Flooding prone (typhoons)</th>
<th>Processing facilities available</th>
<th>Total</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Banana</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>83,0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Grapefruit</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>96,9</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Guava</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>82,9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Longan</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>98,0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Pineapple</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>83,6</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Orange</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>55,1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Litchi</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>55,1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Soursop</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>55,1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Mango</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>88,1</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>Sapodilla</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>40,5</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Passion Fruit</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>83,2</td>
<td></td>
</tr>
</tbody>
</table>

Weighing factor: 6.9, 7.1, 5.0, 6.5, 7.6, 8.7

Similar selection mechanism for Mekong Delta led to Dragon Fruit
1.3 Selection of the two most promising supply chains

Multicriteria evaluation of 11 shortlisted crops and 14 selection indicators resulted in the following selection:

**Dragon Fruit**
Mekong Delta, Long An Province

**Longan**
Red River Delta, Hung Yen Province

Source: IPSARD
1.4 Interviews and measurements

- Goal was to identify FLW hotspots and quantify weight and economic losses
- Interviewees identified via network from local partner AgroInfo
  - Dragon fruit in Longan (Mekong Delta)
  - Longan in Hung Yen (Red River Delta)
- Field trips carried out by AgroInfo (November 2020)
- Measurements for dragon fruit only; again field trip by AgroInfo to Long an in Mekong Delta (January 2021)
- Measurements on FLW and flow size on the spot with scale
1.4 Interviews and measurements

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Dragon Fruit</th>
<th></th>
<th>Longan</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interviews</td>
<td>Measurements</td>
<td>Interviews</td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cooperative</td>
<td>3</td>
<td>n/a</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Trader</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wholesaler</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Retailer</td>
<td>3</td>
<td>n/a</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Exporter</td>
<td>3</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Processor</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

- Interviews are conducted with stakeholders
- Measurements are based on hotspot identification from interviews
2. Hotspots and Opportunities: Dragon Fruit Mekong Delta (Long An Province)

2.1 Flow chart and supply chain characteristics
2.2 Measurement results: food losses and economic losses
2.3 Hotspots losses overview & challenges
2.4 Causes of Post-harvest losses & SWOT
2.5 Top 10 Opportunities to Reduce Losses
2.1 Flowchart and supply chain characteristics

- Lines show all food flows
- Percentages are shares of outgoing flows (weight) to next link

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Producer/cooperative → Processor

Producer/cooperative → Animal feed → Landfill

Trader, sell via barns/collection points → Wholesaler

Wholesaler → 90% Domestic consumer

Wholesaler → Exporter

Exporters: 80% Domestic consumer, 20% International company

International company: 90-95% Domestic consumer, 5-10%

Retailer: 70-80% Producer/cooperative, 100%

Retailer: 5-10% Domestic consumer, 100%

Domestic consumer: 100%

Unknown: 70-80% Producer/cooperative
2.1 Flow chart and supply chain characteristics

<table>
<thead>
<tr>
<th>Producer (cooperation)</th>
<th>Trader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest date determined by counting days</td>
<td>Mainly verbal agreements are made, written contracts only when needed for new customers</td>
</tr>
<tr>
<td>Half-day harvest per time and placed under shed or indoors afterwards. Sell on the same day</td>
<td>Arrange transport from producers to own barn/warehouse (by (mini)truck), within 24 hours</td>
</tr>
<tr>
<td>Very dependent on traders</td>
<td>Sorting and grading occur at own facility or at producers’ farm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wholesaler</th>
<th>Retailer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits are delivered by the seller or wholesalers are responsible for transport ((mini)truck or tricycle)</td>
<td>Purchase based on verbal agreements only</td>
</tr>
<tr>
<td>Wholesalers rinse the product with a machine</td>
<td>Products are delivered or retailers use motorbike to pick it up</td>
</tr>
<tr>
<td>Wholesalers with cold storage facility store for 1-10 days on average. Wholesalers without cold storage facility store for about 1 hour</td>
<td>Products are stored in the store under normal conditions or in a cold storage facility (4-7 days). Sell within 1-3 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exporter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality standards for purchasing include appearance, amount of pesticides left and lab test results</td>
<td></td>
</tr>
<tr>
<td>Sorting and grading is done manually</td>
<td></td>
</tr>
<tr>
<td>Big exporters always pick up the fruit (cooled truck)</td>
<td></td>
</tr>
<tr>
<td>Perform extra rinse and heat treatment when exported to some specific countries. Use cold storage facility</td>
<td></td>
</tr>
</tbody>
</table>
## 2.2 Measurement results: food losses and economic losses

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Weight loss (%)</th>
<th>Value loss (%)</th>
<th>Weight loss/ton</th>
<th>Value loss/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer</td>
<td>3-9% dry season 10-20% wet season</td>
<td>5-9% dry season 10-20% wet season</td>
<td>≈0.1 tons</td>
<td>1,7 Million VND (≈61 EUR)</td>
</tr>
<tr>
<td>Trader</td>
<td>1-2%</td>
<td>6-10%</td>
<td>0.02 tons</td>
<td>1,2 Million VND (≈43 EUR)</td>
</tr>
<tr>
<td>Wholesaler</td>
<td>1-2%</td>
<td>2-10%</td>
<td>0.02 tons</td>
<td>1,3 Million VND (≈47 EUR)</td>
</tr>
<tr>
<td>Processor</td>
<td>Only 1 processor, data not indicative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exporter China</td>
<td>negligible</td>
<td>1-3%</td>
<td>Negligible</td>
<td>0.38 Million VND (≈14 EUR)</td>
</tr>
<tr>
<td>Exporter EU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Sea</td>
<td>20-40%</td>
<td>20-40% (rejected)</td>
<td>0.3 tons</td>
<td>20.4 Million VND (735 EUR)</td>
</tr>
<tr>
<td>- Air</td>
<td>5% (estimated)</td>
<td>5% (estimated)</td>
<td>0.05 tons</td>
<td>7.5 Million VND (270 EUR)</td>
</tr>
</tbody>
</table>

### Prices (2020):
- Average price at farm: ≈ 10,000 VND/kg (≈0.36 EUR/kg)
- Average price at trader: ≈ 13,500 VND/kg
- Average price at wholesaler (export): ≈ 22,000 VND/kg
- Average price importer NL pays: ≈ 150,000 VND/kg (incl. air transp.)
- Average price importer NL pays: ≈ 68,000 VND/kg (incl. sea transp.)
2.3 Hotspots losses overview & challenges

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Harvest</th>
<th>Washing</th>
<th>Sorting/grading</th>
<th>Selling</th>
<th>Transport/transfer</th>
<th>Packaging</th>
<th>Storage</th>
<th>Rinse &amp; heat treatment</th>
<th>Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producer</strong></td>
<td><strong>Losses</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Value</strong></td>
<td><strong>Losses</strong></td>
<td>Few losses</td>
<td>Small value losses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Trader</strong></td>
<td></td>
<td><strong>Value &amp; Losses</strong></td>
<td></td>
<td></td>
<td><strong>Few losses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wholesaler</strong></td>
<td></td>
<td></td>
<td><strong>Value &amp; Losses</strong></td>
<td></td>
<td><strong>Few losses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Export</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Importer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Value &amp; Losses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Main losses**

Index

- Not an activity
- Activity but no hotspot
- Loss Hotspot
- Economic Hotspot
- Loss and Economic Hotspot
2.3 Hotspots losses overview & challenges

- Sorting & grading give the highest economic losses for producers, traders, wholesalers, and importers
  - Partly due to scratches, crushing and breaking ears due to transport, packaging material and over-packing
  - Partly due to pre-harvest problems, like too small, ‘ugly’, no ears, cracked and eaten by snails
- In high season a lower quality and more losses, in off-season (lightening) quality is better and losses are less
  - pests and diseases give higher losses
  - rainy days give lower quality
- Some oversupply in high season (farmers partly don’t harvest, sometimes up to 50%)
- No seamless cold chain after harvesting
- A lot of manual work is done (more inconsistency than mechanized operations)
- Markets with long lead times (EU, USA) are difficult to reach with good quality
2.4 Causes of Post-harvest losses & SWOT

<table>
<thead>
<tr>
<th>Causes/Stakeholder</th>
<th>Farmer</th>
<th>Trader</th>
<th>Wholesaler</th>
<th>Exporter</th>
<th>Importer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting, sorting and grading (lack of good practices, careless handling)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Transport (poor transport packaging, poor roads, long lead time)</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pests and diseases</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oversupply/unharvested produce</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dehydration (uncooled)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fungi (rainy season)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### 2.4 SWOT

**Strengths**
- All good quality dragon fruits can be sold as fresh fruit
- Large wholesalers and retailers, and exporters have cold storage facilities (W, E)
- Experience with exporting but mainly short distance, and exporters use sources that meet the VietGAP standards (E)
- Low quality fruits can be sold to processors
- Stakeholders pay attention to careful handling
- Packaging material is cleaned when re-used, or new packaging material is used

**Weaknesses**
- High yield gap, due to problems with flowering, diseases, spraying, weather conditions and insects (P, C)
- Lower quality produce in main season (rainy season)
- High losses of sorted out dragon fruits in the supply chain
- Sorting and grading, and packing is labour intensive and therefore costly
- Packaging material causing bruises and overloading of baskets up to 50-70 kg/basket (T)
- Almost no cold storage and cold transport facilities and experience with it (P, C, T, W)
- High economic losses (P, C)
- Limited knowledge on how to increase shelf life and quality and limited incentives

**Opportunities**
- Improve growing techniques and handling (P, C)
- Improve roads and network to decrease the amount of damages and bruises
- Install seamless cold chain
- Develop better packing material
- Switch from manual sorting/grading/packaging to mechanized (T, W, E)
- Reduce economic losses by better alignment to market demands/requirements
- Targeting new and more high-end markets
- Increase shelf life a.o. shorten lead times, understand physiology of fruit, seamless cold chain, improved practices
- Export market associates dragon fruit with Vietnam

**Threats**
- High dependency on China who absorbs ~ 80/90% of the volumes and has little to no demands regarding GAP and certifications
- Export to more distant area’s goes mainly via air freight (small volumes, costly, high emissions)
- Access to financial support is difficult (P, C)
- Poor road conditions causing bruised- and damaged fruits
- Over-supply in the main season & due to the pandemic (Covid-19)
- Only a very limited amount of plant protection substances is officially registered
- Price: High fluctuations, not based on standards or regulations
- Chinese customers determine selling prices
- Need for a system approach and long-term chain and stakeholder commitment to reduce FLW systematically

P = producer, C = cooperative, T = trader, W = wholesaler, E = exporter
2.5 Top 10 opportunities in dragon fruits to reduce losses

A) Create economies of scale (farmer cooperation) B) Improve growing techniques and postharvest handling to increase the quality of the produce. This will result in a higher economic value.

Install seamless cold chain and climatic control (relative humidity) to extend the shelf life and therefore prolong the sales window.

A) Improve roads, infrastructure, and logistic design B) Reduce lead times in Vietnam from production area to point of export.

Improve packing material and packing techniques.

Use more automatic systems in sorting & grading, and packing and information flow.
2.5 Top 10 opportunities in dragon fruits to reduce losses

- Make long term commitments on quantity and quality throughout the supply chain.
- Focus with larger volumes on new international markets to become less dependent on China.
- Do research on the physiology of dragon fruits and establish good practice protocols and standards.
- After shelf life is prolonged shift from air- to sea freight.
- Training and certification.

WAGENINGEN UNIVERSITY & RESEARCH
3. Hotspots and Opportunities: Longan Red River Delta (Hung Yen Province)

3.1 Flow chart and supply chain characteristics
3.2 Food Losses and Waste hotspots & main challenges
3.3 SWOT
3.4 Top 6 opportunities for longan to reduce losses
3.1 Flow chart and supply chain characteristics

- Lines show all food flows
- Percentages are shares of outgoing flows (weight) to next link
### 3.1 Flow chart and supply chain characteristics

<table>
<thead>
<tr>
<th>Producer (cooperation)</th>
<th>Trader</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Harvest data determined by appearance and taste</td>
<td>- Quality standards taken into account when purchasing include type, colour and size</td>
</tr>
<tr>
<td>- Three people can harvest one tree in 1 hour</td>
<td>- Sometimes they purchase the complete harvest before being harvested. Then use written contract</td>
</tr>
<tr>
<td>- Sorting &amp; grading is based on type of longan and size/weight (uniform size wanted)</td>
<td>- Transport conducted by trader with truck</td>
</tr>
<tr>
<td>- Sorting and grading is done manually</td>
<td>- Fruits are sold 1-2 days, shelf life after selling ~ 5 days</td>
</tr>
<tr>
<td>- Is sold within 1 day, and remaining shelf life is 4-7 days when preserved in 20 degrees Celsius</td>
<td>- Lower quality fruit is sold to processors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wholesaler</th>
<th>Retailer</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Fruits are delivered by the seller or wholesalers are responsible for transport (truck)</td>
<td>- Products are delivered or retailers use motorbike to pick it up.</td>
</tr>
<tr>
<td>- Products are stored in a warehouse under ambient conditions for max 1-2 days</td>
<td>- The groceries store the fruits under ambient conditions in their shop. The interviewed supermarket has air-conditioning.</td>
</tr>
<tr>
<td>- Fruits are packed manually and sold with and without stalks separately</td>
<td>- They sell within 1-3 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>- In the Vietnamese production season they source from Vietnam; in off-season they import longan from Thailand</td>
</tr>
<tr>
<td>- The final product is mainly exported to China (90%), the remaining is sold to the domestic market</td>
</tr>
<tr>
<td>- In main season, products are delivered by the producers or the processor use mini-van or motorbike to pick it up</td>
</tr>
<tr>
<td>- The products are manually sorted and graded in three grades (A, B, C) based on appearance and the level of damage</td>
</tr>
<tr>
<td>- Processing includes: removing branches, washing, separation of the pulp from the shell and drying</td>
</tr>
<tr>
<td>- The shelf life is ~ 2 years if processed &amp; packed well</td>
</tr>
</tbody>
</table>
### 3.2 Food Losses and Waste Hotspots & challenges

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Harvest</th>
<th>Sorting/grading</th>
<th>Selling</th>
<th>Transport</th>
<th>Packaging</th>
<th>Storage</th>
<th>Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producers</strong></td>
<td>Value &amp; Losses</td>
<td></td>
<td>Value &amp; Losses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Traders</strong></td>
<td>Value &amp; Losses</td>
<td>Value &amp; Losses</td>
<td></td>
<td>Value &amp; Losses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wholesaler</strong></td>
<td>Value &amp; Losses</td>
<td></td>
<td>Value &amp; Losses</td>
<td>Losses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Processor</strong></td>
<td></td>
<td></td>
<td>Losses</td>
<td>Losses</td>
<td></td>
<td></td>
<td></td>
<td>Losses</td>
</tr>
</tbody>
</table>

**Index**
- Not an activity
- Activity but no hotspot
- Loss Hotspot
- Loss and Economic Hotspot

**Main losses**
3.2 Food Loss and Waste hotspots & main challenges

Main challenges

- There are a lot of loss hotspots in the supply chain
  
  A. Sorting and grading give the highest losses for producers, traders and wholesalers
     - Losses due pre-harvest causes like extreme weather conditions (high temperatures and rains), diseases, no proper use of fertilizer, and cracked and rotten longan
  
  B. The wholesaler, retailer, and processor have high losses in storage
     - Rot disease occur due to high ambient temperature
  
  C. The wholesaler and processor have high losses due to transport
     - Damaged products due to collision/bruising

- Processing the fresh longan into dry longan is not optimal (inefficient technology)

- Difficult to preserve the longan under ambient conditions due to the high temperatures

- The quality of longan is not optimal. Competition for the small amount of excellent quality fruits
### 3.3 SWOT

#### Strengths
- Harvest moment based on clear visual changes and harvest several moments in the season (P, C)
- Stakeholders pay some attention to careful handling
- Stakeholders often sell within 1-2 days
- Able to sell all good longan quality
- Lower quality fruits can be sold to processors
- Retailers do business with long-term and trustworthy sellers (R)
- Processed (dried) longan can be stored for 2 years

#### Weaknesses
- High yield gap due to problems with pest, diseases, fertilizer and weather conditions (P, C)
- High losses of out-sorted longan in the supply chain (including processing)
- Most longan are of medium quality, instead of excellent quality
- Storage for a long time is difficult under ambient conditions
- Harvest occur independent on the weather at that moment (P, C)
- No year-round supply: harvest only from May-September
- Sorting & grading is labour intensive and still very traditional
- Overpacking fruits for transport

#### Opportunities
- Improve growing techniques and handling to increase the quality of the fruits (high demand for excellent quality fruits)
- Install seamless cold chain
- Extend/prolong the Vietnamese production season
- Differentiate from other producers with new type of longan products (P, C)
- Improve roads to decrease the amount of bruises and products off-the-stalks due to transportation
- Increase the domestic consumption to other areas in Vietnam
- Improve the drying technology

#### Threats
- Weather conditions at the moment of harvesting and transportation (rain, hot temperatures)
- Poor road conditions causing losses
- High temperatures during the often long transport
- Competition with other domestic stakeholders for the excellent quality fruits
- Depending on imported longan during off-season (PC)
- Poor reputation in the export market in the EU, e.g. extension of maximum residue levels

---

P = producer, C = cooperative, T = trader, W = wholesaler, E = exporter
3.4 Top 6 opportunities for Longan to reduce losses

1. Technical training on production and postharvest handling
2. Install seamless cold storage facilities (directly from harvesting to storage) and climatic control to extend the shelf life and therefore prolong the sales window
3. A) Improve roads, infrastructure, and logistic design B) Reduce lead times in Vietnam from production area to point of sales
4. Improve the drying facilities at the processor
5. A) Do research on the physiology and establish good practice protocols and standards. B) Target new varieties with better shelf life and a longer production window
6. Extend the domestic consumption to other areas in Vietnam
4. Feasible interventions to reduce Food Losses

4.1 Context of interventions
4.2 Dragon fruit: market and market requirements (export)
4.3 From longlist to shortlist of interventions and stakeholders
4.4a Example of a promising business case
4.4b Pros and cons supply by air from Vietnam to Europe
4.4c Pros and cons supply by sea from Vietnam to Europe
4.4d Scenario comparison of Food Loss and Waste and Greenhouse Gas Emissions
4.5 Investment space for food losses reduction
4.6 Intervention based on investment space
4.7 Monthly opportunity for dragon fruit export to EU by sea
4.8 Pros and cons of vertical backward integration via the exporter
4.9 Preliminary assessment of pre-conditions for readiness of uptake of Dutch commercial solutions to reduce Food Loss and Waste in dragon fruit in Vietnam
4.1 Context of interventions

- Cooperation between Vietnamese and Dutch companies (market and technology)
- Shift to high end markets
  - Less dependent on China
  - Higher level of supply chain management (quality, information transfer,...)
  - Higher margins and profits
- EU (via NL) is prominent business case, but Japan, USA and South Korea are interesting markets as well
4.2 Dragon Fruit: Market & Market requirements (export)

- Varieties (Red skin/white flesh, Red skin/red flesh, Yellow skin/white flesh)
- Different preferences in weight
- Different price levels
- Different requirements (law and consumer)
- Market size/potential
- Competition (own production China)
- Seasonality

China: 1 Million tons on 39,000 ha (2018)
Vietnam: 1.25 Million tons on 52,000 ha (2019)
4.2 Dragon Fruit: market and market requirements

**EUROPE**

**Markets**
- Scandinavian countries, Eastern Europe, France
- More out of home, little retail in the Netherlands
- Within the EU little to no market demand for organic
- White meat dragon fruits a bit more dominant than red dragon fruit

**Requirements**
- Certifications: GlobalGap, social certificate (Grasp, SMETA, Fairtrade, Rainforest Alliance), BRC/IFS (Food Safety Certificate)
- Compliance with **Maximum Residue Levels (MRL) EU**
- Sizes 8, 9, 10 (mainly smaller sizes than markets in Asian region)
- Brix, standard quality requirements regarding defects and packaging
## 4.2 Dragon fruit: market and market requirements

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Requirements</th>
</tr>
</thead>
</table>
| **China**   | - Beautiful appearance, the skin is bright red, uniform, scratch-free, the leaf ears on the fruit are green.  
- The fruit structure must be solid, no insect stings, no disease marks and no defect, no chemical drug residues are above the permitted threshold |
| **Japan/Korea** | - **Vapor Heat Treatment**  
- Must satisfy the standards of nutritional quality, phytosanitary and pesticide residues  
- Packaging (Japan): must clearly state the dragon fruit that has been inspected and certified by the Plant Protection Department  
- Packaging (Korea): sealed in each packing box as specified by the Plant Protection Department and the shipment must be covered with insect repellent mesh |
| **USA** | - The dragon fruit is allowed to export to the US market are red and white flesh one  
- All shipments of dragon fruits from Vietnam, when being exported to the US, must meet the conditions of technical standards and origin:  
  + Planting area code  
  + Code of packing establishment  
  + **Code of the irradiation treatment plant**  
- SPS Agreement (the Agreement on food hygiene and safety and plant and animal quarantine), ensuring food safety and hygiene, the amount of plant protection drugs and other residues are below the permitted level, there are no pests and diseases that are of concern to the US (especially fruit flies) |
## 4.2 Dragon Fruit: Market & Market requirements

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Weight/size (gram)</th>
<th>Lead time(days) (arriving in other country)</th>
<th>Import price 2020 (VND/kg) (including transport)</th>
<th>Wholesaler price 2020 (VND/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>~ 400-600</td>
<td>1-3</td>
<td>22,000 (truck)</td>
<td>n.a.</td>
</tr>
<tr>
<td>Japan/Korea</td>
<td>~ 350-500</td>
<td>3-5/7-9</td>
<td>45,000-70,000 (sea)</td>
<td>n.a.</td>
</tr>
<tr>
<td>USA</td>
<td>~ 300-350</td>
<td>2 (air)</td>
<td>170,000 (air)</td>
<td>230,000 (air)</td>
</tr>
<tr>
<td>EU</td>
<td>~ 250-300</td>
<td>2 (air)/26 (sea)</td>
<td>150,000 (air) / 68,000 (sea)</td>
<td>275,000-330,000 (air)</td>
</tr>
</tbody>
</table>

(all data pre-covid; beginning of 2020)
4.3 From longlist to shortlist of interventions and stakeholders

Approach dragon fruit:

- Identification Vietnamese companies (exporters, processors) by AgroInfo
- Identify Dutch companies (importers, technology/hardware providers) by WUR
- Interview all companies and funnel them (done by AgroInfo and WUR) according to selected criteria (e.g. size, willingness/interest, ...)
- List interventions based on findings on hotspots and challenges

For longan interventions were identified rather than Vietnamese companies, since potential for Vietnamese-Dutch collaboration is limited (domestic market (in general not high-end), small investment space)
4.3 From longlist to shortlist of interventions and stakeholders

- From ~80 to ~30 potentially interested companies (only for dragon fruit)
- ~90 interventions to 2-3 interventions per crop

**Criteria for companies**
- Can influence Food Losses (chain actor, offer technology/services reducing Food Losses)
- Interested in this project

**Criteria for interventions**
- Impact
- Contribute to Dutch-Vietnamese collaboration
- Post-harvest chain
4.3 From longlist to shortlist of interventions and stakeholders

- Importers (conventional and organic fruits), organic < opportunities
- Traders
- Service providers: logistics, shipment, warehousing
- Hardware providers: cold chain solutions (pre-cooling, cold storage)
- Consultants
- Solutions providers for the primary production
- Bank

Interviews in the Netherlands

In general interested in this project but mainly in dragon fruit

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EU organic farming logo

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WAGENINGEN UNIVERSITY & RESEARCH

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4.3 From longlist to shortlist of interventions and stakeholders

Result

✓ 8 Dutch companies, 15 Vietnamese companies (dragon fruit)

- Vertical integration
- Cold chain/shelf-life extension
- Shift to reefer
- Primary production: link to Fruit Force project

Interesting opportunities for both countries

- Little investment space, eventually local solutions
- Primary production: Link to Nuffic OKP-project and/or Fruit Force

Limited opportunities for both countries

https://www.nuffic.nl/en/subjects/orange-knowledge-programme
4.4a Example of promising business case

Export of dragon fruit to EU (via NL) by sea

• Comparison with export to EU by air (most common now)
• Cost analysis based on interviews and field research in Vietnam and the Netherlands
• Two scenarios for both air and sea transport: current situation versus situation where market price in Netherlands is halved (to open up EU market)
### 4.4b Pros and cons supply by air from Vietnam to Europe

#### Pros Air Freight
- Good quality without special treatments & attention at arrival in the Netherlands
- Shelf life for imported dragon fruit still ~ 2 weeks
- A lot of flexibility

#### Cons Air Freight
- High price, fare too high to increase volumes
- High emissions, market prefers to have NO supply of air freight products
- Limited market potential because of high price and little space in plane (0.5–1 ton/wk)

### Retail price comparison:
- NL now: Avocado 105,000 VND/kg

### Lead time (Day number)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>5</th>
<th>7</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current situation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Price VND/EUR kg)</td>
<td>10,000/0.36</td>
<td>13,500/0.49</td>
<td>157,000/5.70</td>
<td>248,000/9.00</td>
</tr>
<tr>
<td>Future scenario</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Price VND/EUR kg)</td>
<td></td>
<td></td>
<td>33,000/1.20</td>
<td>124,000/4.50</td>
</tr>
</tbody>
</table>

### Retail price comparison:
- NL now: Avocado 105,000 VND/kg
- Lead time (Day number) 1
- Current situation (Price VND/EUR kg) 10,000/0.36
- Future scenario (Price VND/EUR kg) 33,000/1.20

*prices pre-covid
### 4.4c Pros and cons supply by sea from Vietnam to Europe

#### Lead time (Day number)**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>5</th>
<th>26-27 (Covid +~5)</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current situation (Price Dong/ EUR kg)</td>
<td>10,000/0.36</td>
<td>13,500/0.49</td>
<td>157,000/5.70</td>
<td>248,000/9.00</td>
</tr>
<tr>
<td>Future scenario (Price Dong/ EUR kg)</td>
<td></td>
<td>83,000/3</td>
<td>2200/0.08*</td>
<td>124,000/4.50</td>
</tr>
</tbody>
</table>

#### Pros Sea Freight
- Increase of business opportunities for one or more reefers/week
- Lowering of unit costs
- Reduction of emissions and meet market preference
- Potential to develop dragon retail market in Europe + markets in region (Korea, Singapore, Australia) spreading risk
- Reducing lead time is possible for supply chain part in Vietnam

#### Cons Sea Freight
- Risk for quality decrease unless good integration with farms
- Need for scaling, investments, and for a different mind set (China just 3 days + little requirements)
- Dragon market still needs to get developed in Europe, dragons are not yet much known
- Less flexibility

*prices pre-covid

**Shelf life dragons Vietnam ~50 days from harvest, literature 42 days
### 4.4d Scenario comparison of Food Loss and Waste and Greenhouse Gas Emissions

<table>
<thead>
<tr>
<th>No</th>
<th>Scenario</th>
<th>Food Losses from harvest to importer in Rotterdam per ton</th>
<th>Greenhouse Gas Emissions from harvest to importer in Rotterdam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current supply chain: from Mekong Delta – HCMC – Rotterdam (by air)</td>
<td>(total estimated at 0.15 tons)</td>
<td>26.5 kg CO2-eq. per kg product</td>
</tr>
<tr>
<td>2</td>
<td>Current supply chain from Mekong Delta – HCMC – Rotterdam (by sea)</td>
<td>0.44 tons</td>
<td>23.7 kg CO2-eq. per kg product</td>
</tr>
<tr>
<td>3</td>
<td>Future scenario, improved supply chain 70 % loss reduction from producer to wholesaler, standard &lt;7% importer: from Mekong Delta – cooling – HCMC – Rotterdam (by boat)</td>
<td>0.13 tons</td>
<td>16.1 kg CO2-eq. per kg product</td>
</tr>
</tbody>
</table>
4.4d Scenario comparison of Food Loss & Waste-Greenhouse Gas Emissions

Scope of scenarios: from harvest in Vietnam to importer in the Netherlands

<table>
<thead>
<tr>
<th>ACE calculator</th>
<th>Agro-Chain greenhouse gases Emissions Calculator</th>
<th>Jan Broeze</th>
<th>Wageningen Food &amp; Biobased Research</th>
<th>Version 19 May 2021</th>
</tr>
</thead>
</table>

**Marketed food product CLIMATE IMPACT**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>FOOD LOSS (lost edible part)</th>
<th>FOOD LOSS ASSOCIATED GHG EMISSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1. Dragon Fruit Vietnam - Europe: Air transport</td>
<td>26.49 kg CO2-EQ. per kg sold on market</td>
<td>2.62 kg CO2-EQ. per kg sold on market</td>
</tr>
<tr>
<td>Scenario 2. Dragon Fruit Vietnam - Europe: Sea transport</td>
<td>23.67 kg CO2-EQ. per kg sold on market</td>
<td>10.36 kg CO2-EQ. per kg sold on market</td>
</tr>
<tr>
<td>Scenario 3. Dragon Fruit Vietnam - Europe: Sea, reduced loss</td>
<td>16.09 kg CO2-EQ. per kg sold on market</td>
<td>1.95 kg CO2-EQ. per kg sold on market</td>
</tr>
</tbody>
</table>

**ACE calculator**

Agro-Chain greenhouse gases Emissions Calculator

**Case/scenario title:** Marketed food product CLIMATE IMPACT FOOD LOSS (lost edible part) FOOD LOSS ASSOCIATED GHG EMISSIONS

**Scenario highlights**

- **Air transport:**
  - High climate impact due to intercontinental air transport
  - Relatively low losses
  - Highest GHG emissions per kg arriving at market

- **Sea cargo transport:**
  - No refrigeration in post-harvest operations
  - (Refrigerated) cargo ship
  - Relatively high losses

- **Cold chain + reduced losses:**
  - Container shipping
  - Climate impact of refrigeration in post-harvest storage is small
  - Lowest losses for this scenario results in lowest climate impact
  - Lowest GHG emissions per kg arriving at market

**Summary of climate impacts results**

<table>
<thead>
<tr>
<th>Overview of climate impacts per chain stage</th>
<th>Direct emissions</th>
<th>FLW-associated</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting and on-field post-harvest operations</td>
<td>12.870</td>
<td>1.510</td>
<td>14.380</td>
</tr>
<tr>
<td>(On-farm) Transport</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Postharvest handling and storage (on-farm)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Transport</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Processing and Packaging</td>
<td>0.000</td>
<td>0.445</td>
<td>0.445</td>
</tr>
<tr>
<td>(Possibly international) Transport</td>
<td>11.003</td>
<td>0.443</td>
<td>11.446</td>
</tr>
<tr>
<td>Processing/repackaging/distribution</td>
<td>0.000</td>
<td>0.662</td>
<td>0.662</td>
</tr>
<tr>
<td>Distribution transport</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Market/Retail shop</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTAL (incl. correction for moisture and residues loss)</td>
<td>23.873</td>
<td>2.617</td>
<td>26.490</td>
</tr>
</tbody>
</table>

**Scenario 1. Dragon Fruit Vietnam - Europe: Air transport**

- Direct emissions: 23.67 kg CO2-EQ. per kg sold on market
- FLW-associated: 10.36 kg CO2-EQ. per kg sold on market
- Total: 34.03 kg CO2-EQ. per kg sold on market

**Scenario 2. Dragon Fruit Vietnam - Europe: Sea transport**

- Direct emissions: 23.67 kg CO2-EQ. per kg sold on market
- FLW-associated: 10.36 kg CO2-EQ. per kg sold on market
- Total: 34.03 kg CO2-EQ. per kg sold on market

**Scenario 3. Dragon Fruit Vietnam - Europe: Sea, reduced loss**

- Direct emissions: 16.09 kg CO2-EQ. per kg sold on market
- FLW-associated: 1.95 kg CO2-EQ. per kg sold on market
- Total: 18.04 kg CO2-EQ. per kg sold on market

**ACE calculator**

Agro-Chain greenhouse gases Emissions Calculator

**Case/scenario title:** Marketed food product CLIMATE IMPACT FOOD LOSS (lost edible part) FOOD LOSS ASSOCIATED GHG EMISSIONS

**Scenario highlights**

- **Air transport:**
  - High climate impact due to intercontinental air transport
  - Relatively low losses
  - Highest GHG emissions per kg arriving at market

- **Sea cargo transport:**
  - No refrigeration in post-harvest operations
  - (Refrigerated) cargo ship
  - Relatively high losses

- **Cold chain + reduced losses:**
  - Container shipping
  - Climate impact of refrigeration in post-harvest storage is small
  - Lowest losses for this scenario results in lowest climate impact
  - Lowest GHG emissions per kg arriving at market
### 4.5 Investment space for food losses reduction

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Export to China</th>
<th>Export to EU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight loss/ton</td>
<td>Value loss/ton</td>
</tr>
<tr>
<td>Farmer</td>
<td>≈0.1 tons</td>
<td>1.7 MVND* / 62 €</td>
</tr>
<tr>
<td>Trader</td>
<td>0.02 tons</td>
<td>1.2 MVND / 44 €</td>
</tr>
<tr>
<td>Wholesaler</td>
<td>0.02 tons</td>
<td>1.3 MVND / 47 €</td>
</tr>
<tr>
<td>Exporter (road)</td>
<td>Negligible</td>
<td>0.38 MVND / 14 €</td>
</tr>
<tr>
<td>Exporter (sea)</td>
<td></td>
<td>0.3 tons</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>0.14 tons</strong></td>
<td><strong>4.58 MVND / 166 €</strong></td>
</tr>
</tbody>
</table>

Production per year/farmer on average = 30 tons

Food loss savings potential: $30 \times 0.1 \text{ tons} = 3 \text{ tons/year} = 30 \text{ Million VND/year (1090 €)}$

Value loss savings potential: $30 \times 1.7 = 51 \text{ Million VND/year (1851 €)}$

If farmers reduce their losses by 70% 25 farms can cooperate and buy a cold storage for 100 tons (with Return of Investment 4 years)
4.6 Intervention based on investment space

Example:
- boat to EU, 1 reefer/week equals 1,000 tons/year
- Sales price increase from 22,000 to 83,000 VND/kg
- 1,000 tons → 61,000 million VND/kg investment space

Investment:
- Cold storage 100 tons: 5,500 Million VND
- Training farmers
- Protocol development (especially harvest: timing and handling)
- Optimize logistics (uniformity, continuity)
- Transport packaging for reefer transport (ventilation, well stackable)
- Mechanization (sorting, washing,...)
4.7 Monthly opportunity for dragon fruit export to EU by sea

<table>
<thead>
<tr>
<th></th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raining Season</td>
<td>⭐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main harvest</td>
<td>⭐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor production season</td>
<td>⭐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export window Spain/ Morocco</td>
<td>⭐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity window for export to Europe</td>
<td>⭐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Most interesting short term**
- **Further research needed***
- **Further research needed***

*So far little research on shelf life extension done, and quality is less in rest of year compared to Dec-April*
4.8 Pros and cons of vertical backward integration via the exporter

**Pros**
- Reliance on quality and quantity
- Economies of scale
- Lower costs
- Transparency

**Cons**
- Needs investments
- Reduces flexibility
- Needs long term vision
- Needs different company culture
4.9 Preliminary assessment of pre-conditions for readiness of uptake of Dutch commercial solutions to reduce Food Loss and Waste in dragon fruit in Vietnam

<table>
<thead>
<tr>
<th>Type of Company in the Netherlands</th>
<th>Relevant services of Dutch company</th>
<th>Main pre-conditions of Vietnamese company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importer of dragon fruits</td>
<td>Import and distribution in Europe, market development, increase of dragon fruit sales</td>
<td>Price reduction by 50%, modality shift from air to sea, improvement of quality and longer shelf life of dragon fruit, drastic increase of quantity so that VN can become no 1 supplier of dragon fruits</td>
</tr>
<tr>
<td>Logistic service providers, warehouse services</td>
<td>Logistic services from door to door, warehousing, packaging, support with import</td>
<td>Increase volume and scale e.g. several containers a week, shift from air to sea, quality mindset, long-term commitment and plan, access to finance</td>
</tr>
<tr>
<td>Cold storage facilities</td>
<td>Tailored high-tech cold storage facilities, 24/7 service</td>
<td>Sufficient volume and scale, quality mindset, need for longer shelf life due to e.g. shift from air to sea shipments or extension of sales window, access to finance</td>
</tr>
<tr>
<td>Bank</td>
<td>Access to finance for cold storage facilities or other hardware, understanding of the agro business</td>
<td>Bankable business plan with a good return of investment, guaranties, account statement/positive financial balances of the previous years</td>
</tr>
</tbody>
</table>

* For potatoes Dutch companies can also bring on bord certified improved seed varieties and in depth knowledge of storability
5. Main conclusions, recommendations, phases, outlook
5. Main conclusions, recommendations, phases, outlook

Conclusions Phase 1

1. There is little knowledge on FLW in Vietnam in the selected chains. This research provides new insights in this field and shows where to focus on.

2. Although the supply chains of Dragon Fruits and Longan show many differences and also have different target markets, they also have some things in common:
   2.1. For both crops losses hotspots are a) pre-harvest b) sorting & grading. However, next to those hotspots Longan has many other losses hotspots and if dragon fruits are transported via boat to Europe the losses are extremely high.
   2.2. To reduce losses both supply chains could benefit a lot from: a) improved growing techniques b) improved postharvest handling and c) uninterrupted cold chains and climate control d) create economies of scale for transport, labour and knowledge.
   2.3. However, in both supply chains it would need more than only technical solutions to successfully reduce losses. One could think about e.g., long term commitment and agreements through the supply chains, access to finance, access to market information and so on.

3. Losses hotspots and interventions to prevent them are not necessarily located at the same stage in the value chain: e.g., high loss rates during grading and sorting are typically the result of poor initial quality and/or improper handling earlier in the supply chain. Therefore, we need to understand the root causes of the losses to identify the best intervention options.

4. There are many opportunities for Vietnam to reduce the losses and improve product quality of fresh fruit and vegetables. Each crop/product requires an integrated and customized approach, taking into account ‘hardware-, software-, and orgware- solutions’*. An option such as vertical integration could ensure the exporter to receive reliable quality and quantity of fruits.

*Expedition agroparks : research by design into sustainable development and agriculture in network society, P. Smeets (2011)
5. The goal of this project is to reduce food losses in a profitable way by combined efforts of Vietnamese stakeholders and Dutch companies. In dragon fruits there are good opportunities to meet this goal. For the reduction of losses in longan local solutions and suggestions made in this report can be beneficial.

6. To fully develop the business opportunities for Dutch companies a perennial strategic plan is needed which should include a.o. business case development, a communication plan, concrete scaling projects.

**Dragon fruit**

7. There are interesting business cases for supply chain actors to reduce losses by investing in targeted losses reduction measures. For instance, if 25 farmers reduce their losses by 70% they can invest together in one cold storage RoI just 4 years!

8. Losses reduction and quality improvements can open new business opportunities, would for instance allow for export by sea instead of by air to Europe. Also sea transport to other high end markets in the region are within reach.

9. To allow successful export by sea it needs reliable quality and quantity. Therefore, vertical integration of the exporters is suggested.

10. Investing into compliance for export to high end markets means extra effort compared to export to China. Moreover, China is increasing its own production area. It seems likely for the (near) future that their import requirements will converge to similar ones upheld by high-end markets. Therefore, compliance to good practice standards are almost mandatory for supply chain actors.

11. Export development requires two important steps:
   a) vertical integration to reach high-end markets like Japan, Korea and Australia (lead time relatively small)
   b) in addition: optimal cold chain management to have access to far away markets by boat (much more competitive), like EU
5. Main conclusions, recommendations, phases, outlook

Recommendations to raise the interest of Dutch companies in Vietnam

✓ Develop the business case for Dutch solutions in Vietnam
✓ Gain in-depth understanding of the conditions under which Dutch companies would come to Vietnam, understand the reasons why they established sales offices or have representatives in other countries in the region, what made it a success for them to be in those regions, how Vietnam could prepare the ground for Dutch companies in Vietnam
✓ Determine a communication plan to promote the Vietnamese Agricultural sector to Dutch companies (e.g., via trade fairs like Fruitlogistica Berlin/Asia, Horti Asia, publish on a regular base in the media channels which are used by the Dutch business society)
✓ Organize informal meetings with Dutch companies (e.g., ‘Meet and Greet’ with the Agricultural Counsellor and/or selected Vietnamese companies) and business matchmaking meetings (small scale, informal but organized)
✓ Access opportunities for putting improvement suggestions of this project into practice via a perennial project funded for instance via Flying Swan, PPIB, Partners for International Business programme of RVO or other options
5. Main conclusions, recommendations, phases, outlook

Project phases

This report

Phase 1: Hotspots and feasible interventions
8/2020-5/2021

Results
- Hotspots: interventions, investment space, potentially interested actors

Phase 2: Business case dragon fruits, quick scan new product
6/2021-2/2022

Results
- 2 business case studies
- Roadmap Post-harvest loss reduction
- Consortium of ‘The Willing’

Phase 3: Innovative coalition for change, 3-4 years project

Ambition

Aim (2022-2025)
- Design of 1-2 improved supply chains
- Train
- Implement
- Pilot/Test
- Scale... so on
5. Main conclusions, recommendations, phases, outlook

- Loss reduction
- Quality improvement
- Quantity Increase
- Increase of export to the Netherlands and/or other high end markets with need of longer shelf life and guaranteed quality

Outlook Roadmap for Post-Harvest loss reduction in Vietnam with Dutch knowledge

- Increase of opportunities for Dutch companies in Vietnam
- Increase of uptake of Dutch solutions and activities in Vietnam

Scaling plan

Vietnam agri-food actor
Let that be the beginning of a fruitful collaboration on Food Loss and Waste reduction and new business opportunities.

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