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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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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Index Presentation

1. Project Framework

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- 1.2 Definitions
- 1.3 Selection of the two most promising supply chains
- 1.4 Interviews and measurements

1.1 Goal, Methodology and Steps

Goal

Reduce Food losses in the Vietnames 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

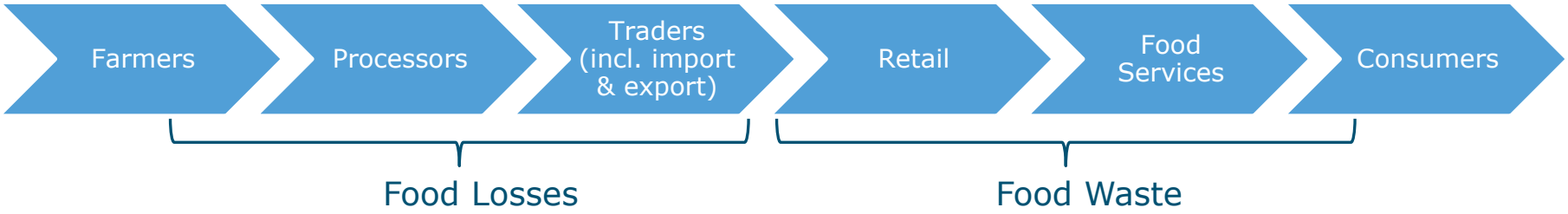
- Literature Research
- Field Visits
- Food Measurements in Dragon Fruit Losses
- In Depth Interviews in Vietnam & The Netherlands

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.

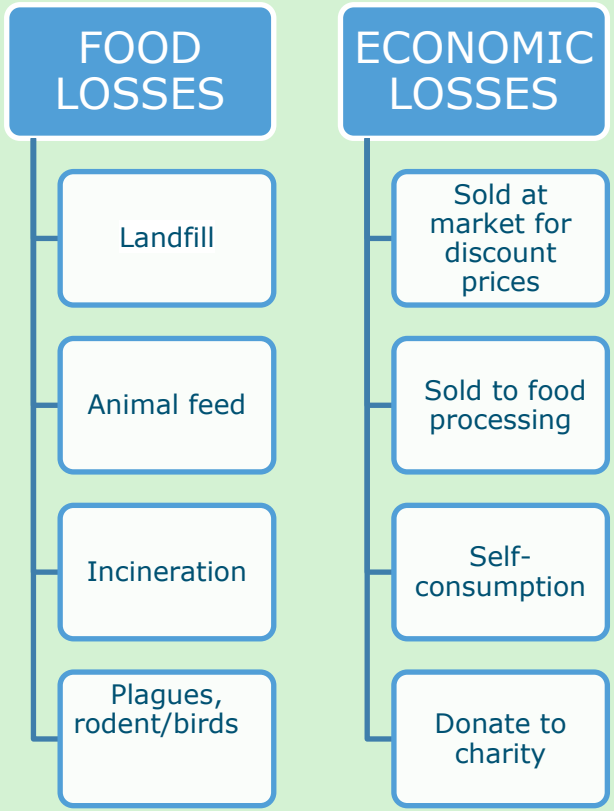


Within this project, a further distinction is made between:

- 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:



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 proces 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

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

Similar selection mechanism for Mekong Delta led to Dragon Fruit

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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

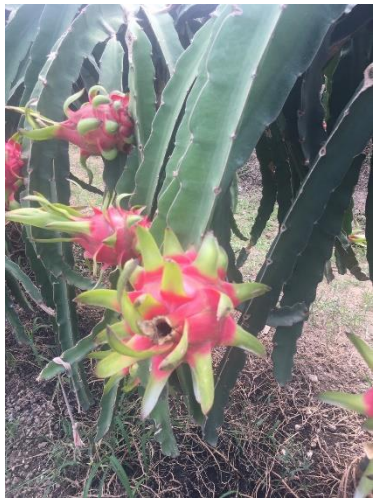
1.4 Interviews and measurements

Stakeholder	Dragon Fruit		Longan
	Interviews	Measurements	Interviews
Producer	2	5	2
Cooperative	3	n/a	3
Trader	3	2	3
Wholesaler	3	2	3
Retailer	3	n/a	3
Exporter	3	n/a	n/a
Processor	1	1	1

- 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







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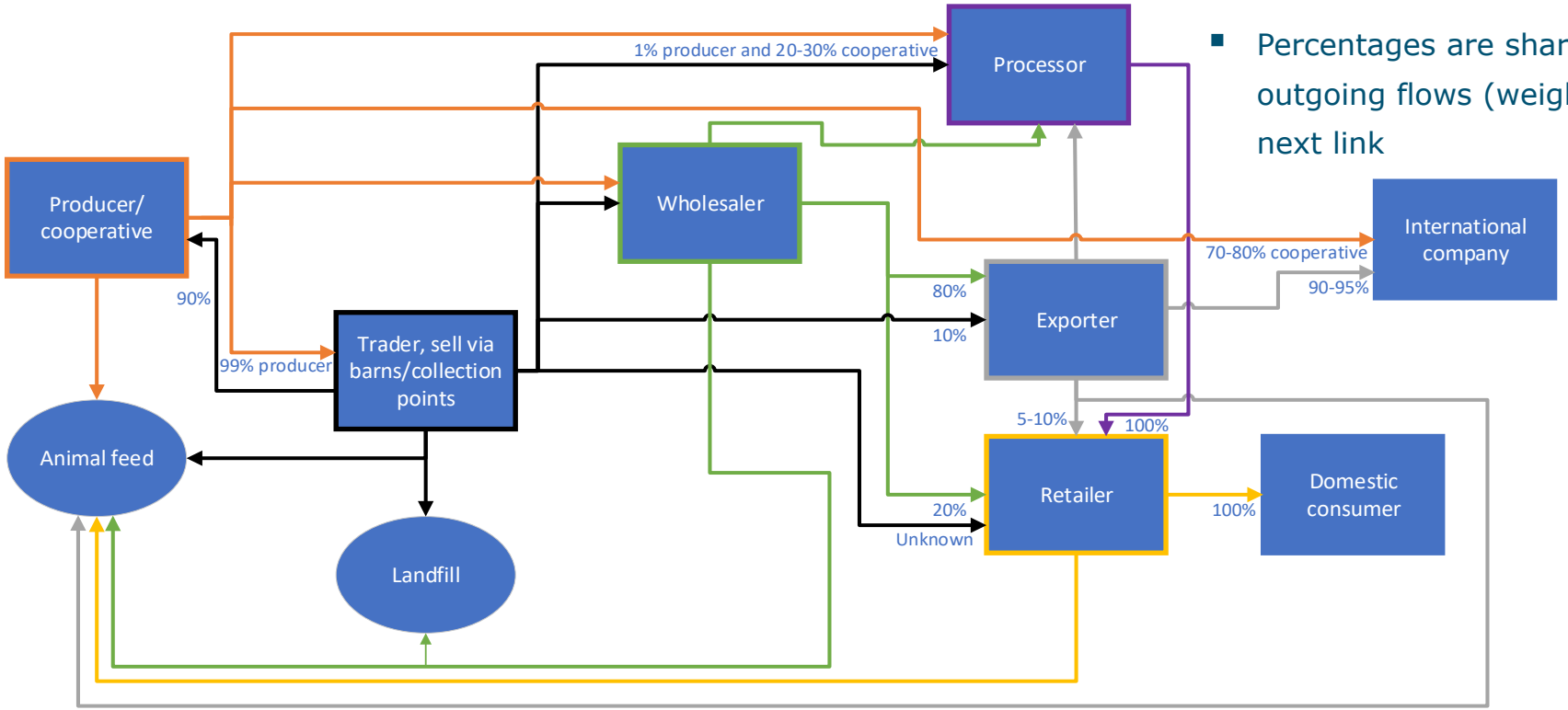
2.1 Flowchart and supply chain characteristics

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



2.1 Flow chart and supply chain characteristics

Producer (cooperation)
- Harvest date determined by counting days
- Half-day harvest per time and placed under shed or indoors afterwards. Sell on the same day
- Very dependent on traders

Trader
- Mainly verbal agreements are made, written contracts only when needed for new customers
- Arrange transport from producers to own barn/warehouse (by (mini)truck), within 24 hours
- Sorting and grading occur at own facility or at producers' farm
- Packaging is done in 50 kg baskets with newspaper layer

Wholesaler
- Fruits are delivered by the seller or wholesalers are responsible for transport ((mini)truck or tricycle)
- Wholesalers rinse the product with a machine
- Wholesalers with cold storage facility store for 1-10 days on average. Wholesalers without cold storage facility store for about 1 hour

Retailer
- Purchase based on verbal agreements only
- Products are delivered or retailers use motorbike to pick it up
- Products are stored in the store under normal conditions or in a cold storage facility (4-7 days). Sell within 1-3 days

Exporter
- Quality standards for purchasing include appearance, amount of pesticides left and lab test results
- Sorting and grading is done manually
- Big exporters always pick up the fruit (cooled truck)
- Perform extra rinse and heat treatment when exported to some specific countries. Use cold storage facility

2.2 Measurement results: food losses and economic losses

Stakeholder	Weight loss (%)	Value loss (%)	Weight loss/ton	Value loss/ton
Farmer	3-9% dry season 10-20% wet season	5-9% dry season 10-20% wet season	≈0.1 tons	1,7 Million VND (~61 EUR)
Trader	1-2%	6-10%	0.02 tons	1,2 Million VND (~43EUR)
Wholesaler	1-2%	2-10%	0.02 tons	1,3 Million VND (~47 EUR)
Processor	Only 1 processor, data not indicative			
Exporter China	negligible	1-3%	Negligible	0,38 Million VND (~14 EUR)
Exporter EU				
- Sea	20-40%	20-40% (rejected)	0.3 tons	20,4 Million VND (735 EUR)
- Air	5% (estimated)	5% (estimated)	0.05 tons	7,5 Million VND (270 EUR)

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.)
  ≈ 68,000 VND/kg (incl. sea transp.)

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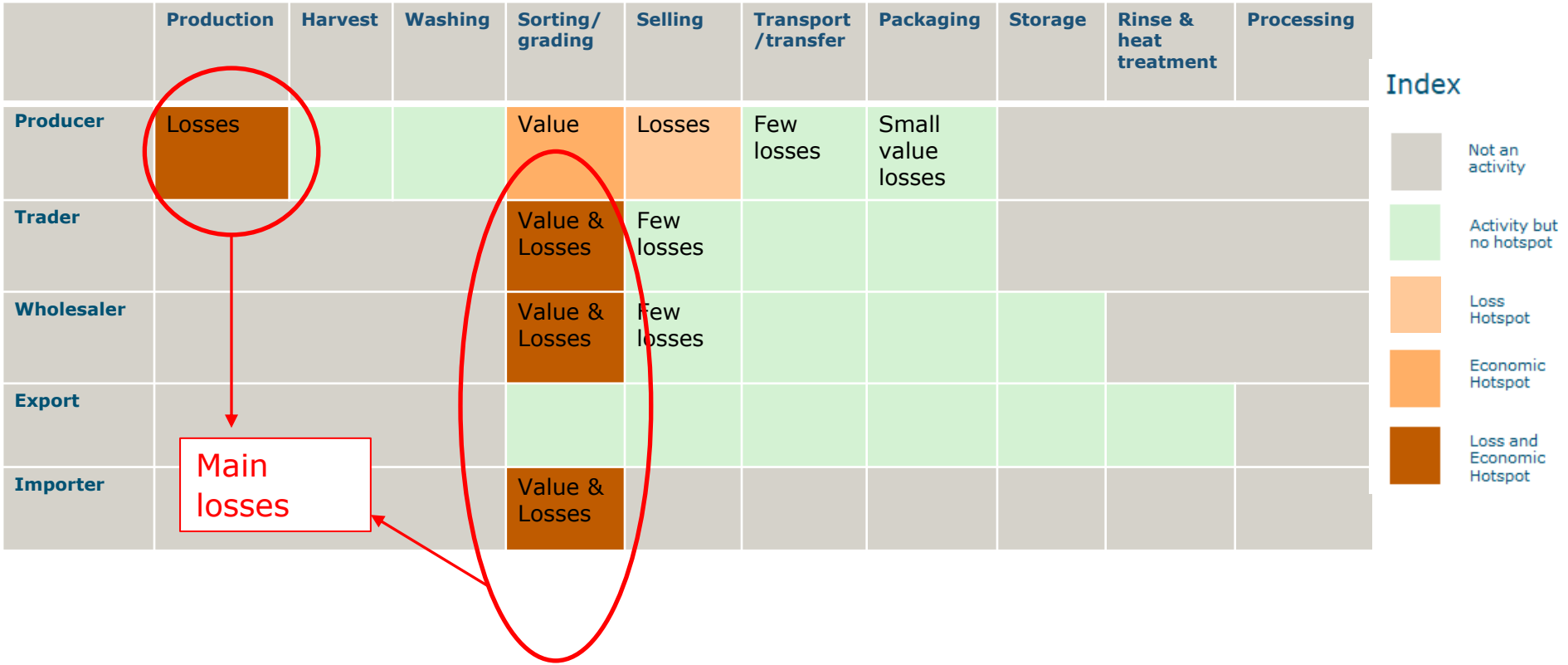
2.3 Hotspots losses overview & challenges



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

Causes/Stakeholder	Farmer	Trader	Wholesaler	Exporter	Importer
Harvesting, sorting and grading (lack of good practices, careless handling)	X	X	X	X	X
Transport (poor transport packaging, poor roads, long lead time)		X		X	X
Pests and diseases	X	X	X	X	X
Oversupply/unharvested produce	X				
Dehydration (uncooled)	X				X
Fungi (rainy season)	X	X			X

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

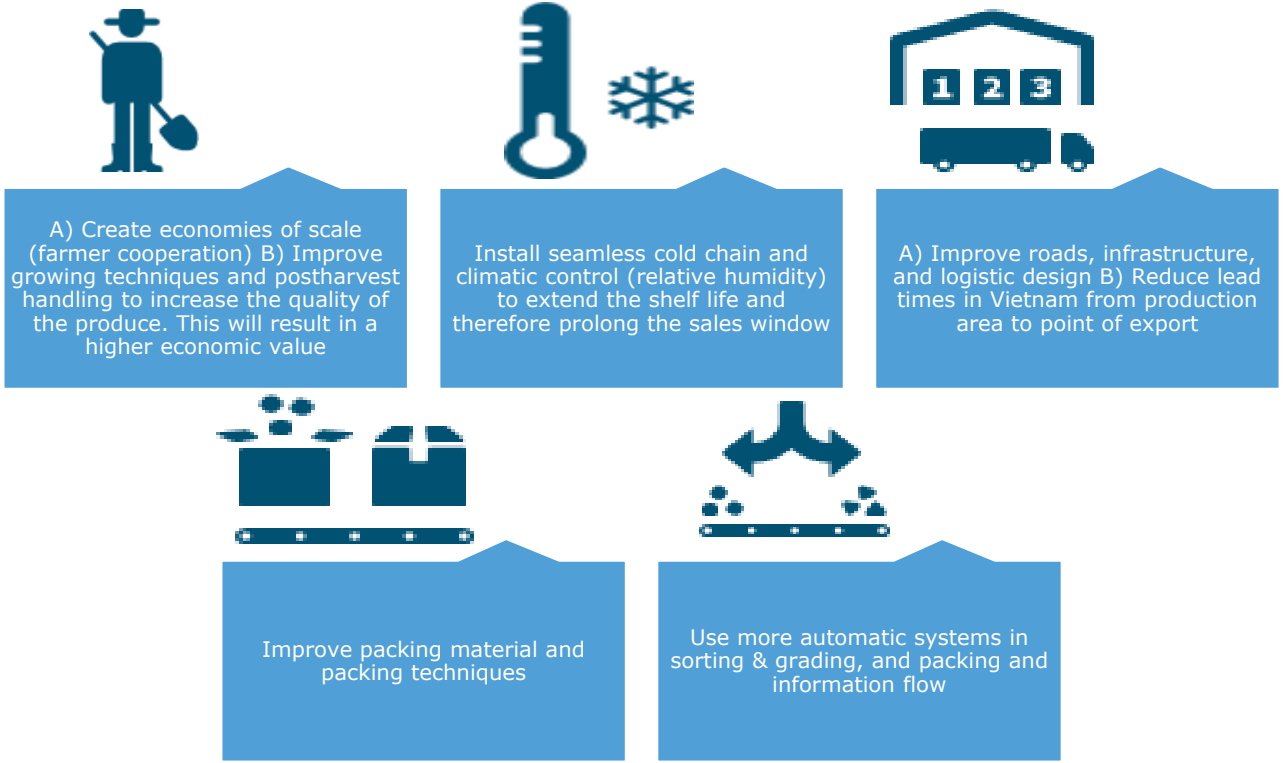
Weaknesses
- High yield gap, due to problems with flowering, diseases, spraying, weather conditions and insects (P, C)
- Lower quality produce in main season (rainy season)
- High losses of sorted out dragon fruits in the supply chain
- Sorting and grading, and packing is labour intensive and therefor 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



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

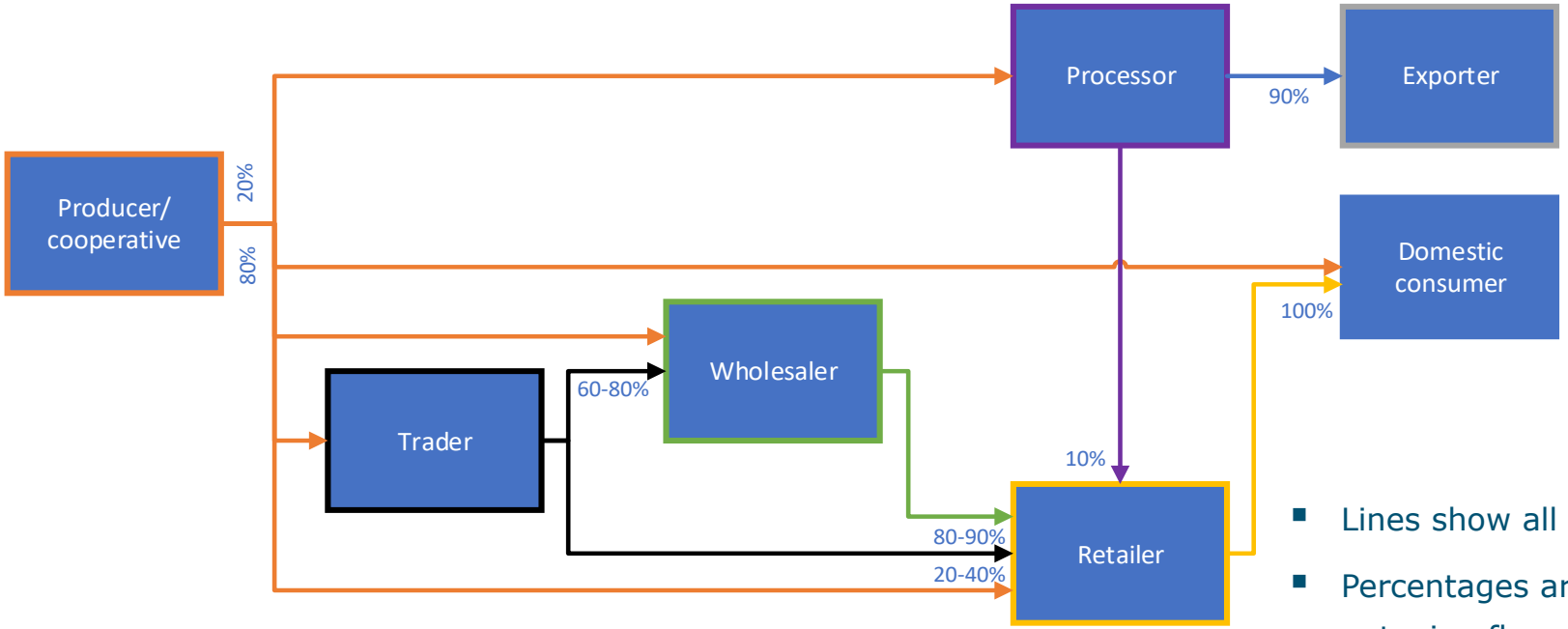
3. Hotspots and Opportunities: Longan Red River Delta (Hung Yen Province)

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

Producer (cooperation)
- Harvest data determined by appearance and taste
- Three people can harvest one tree in 1 hour
- Sorting & grading is based on type of longan and size/weight (uniform size wanted)
- Sorting and grading is done manually
- Is sold within 1 day, and remaining shelf life is 4-7 days when preserved in 20 degrees Celsius

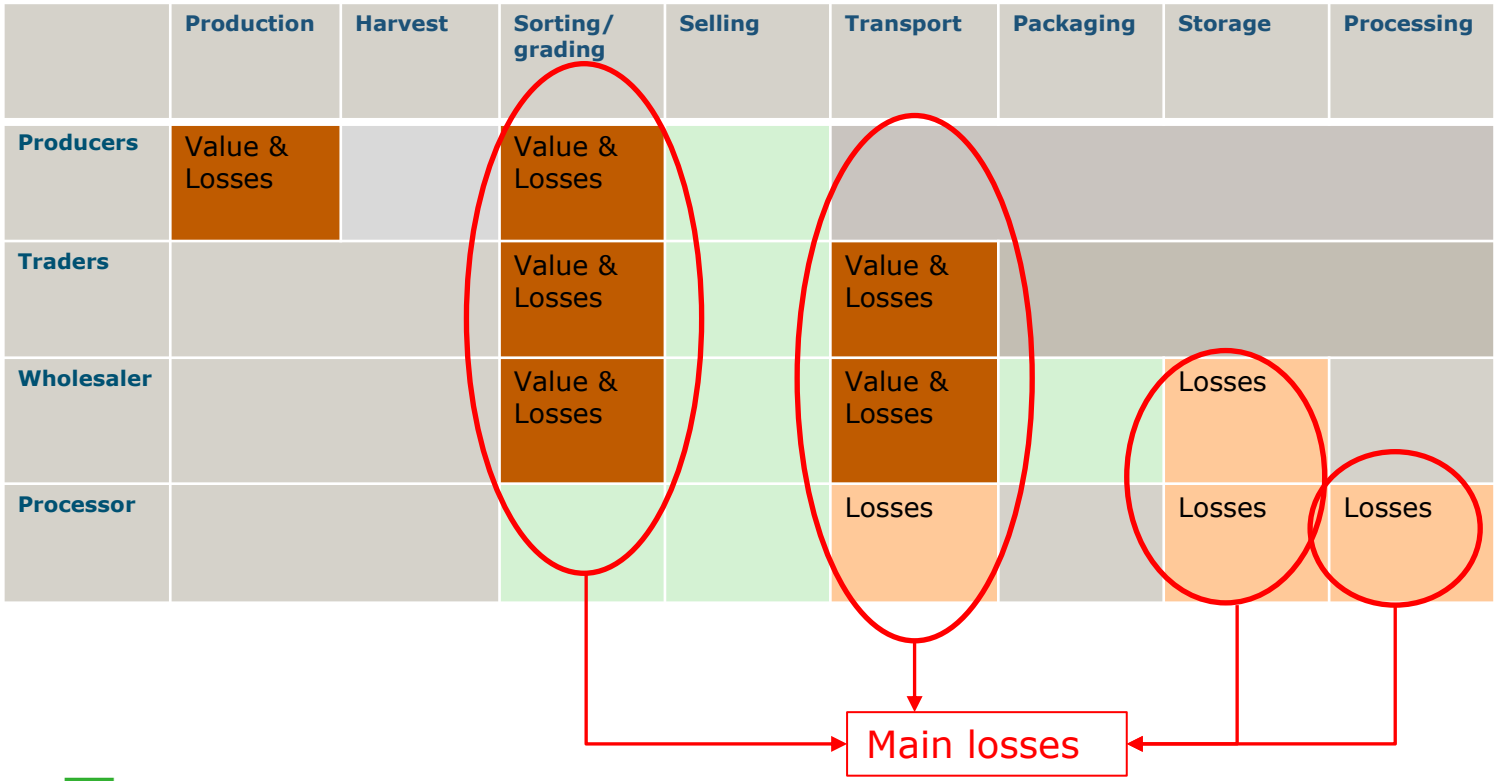
Trader
- Quality standards taken into account when purchasing include type, colour and size
- Sometimes they purchase the complete harvest before being harvested. Then use written contract
- Transport conducted by trader with truck
- Fruits are sold 1-2 days, shelf life after selling ~ 5 days
- Lower quality fruit is sold to processors

Wholesaler
- Fruits are delivered by the seller or wholesalers are responsible for transport (truck)
- Products are stored in a warehouse under ambient conditions for max 1-2 days
- Fruits are packed manually and sold with and without stalks separately

Retailer
- Products are delivered or retailers use motorbike to pick it up.
- The groceries store the fruits under ambient conditions in their shop. The interviewed supermarket has air-conditioning.
- They sell within 1-3 days

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

3.2 Food Losses and Waste Hotspots & challenges



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

Technical training on production and postharvest handling

Install seamless cold storage facilities (directly from harvesting to storage) and climatic control 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 sales

Improve the drying facilities at the processor

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

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

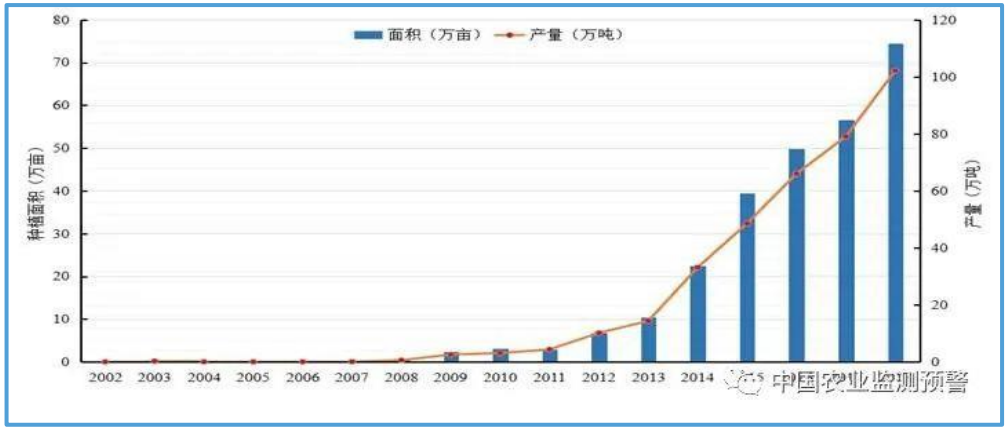
4.9 Preliminary assessment of pre-conditions for readiness of uptake of Dutch commercial solutions to reduce Food Loss and Waste in dragon fruit in Vietnam

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

GLOBALG.A.P.
The Global Partnership for Safe and Sustainable Agriculture

GRASP
Global G.A.P.

BRC FOOD CERTIFICATED

IFS Food

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4.2 Dragon fruit: market and market requirements

Stakeholder	
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

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

(all data pre-covid; beginning of 2020)

4.3 From longlist to shortlist of interventions and stakeholders

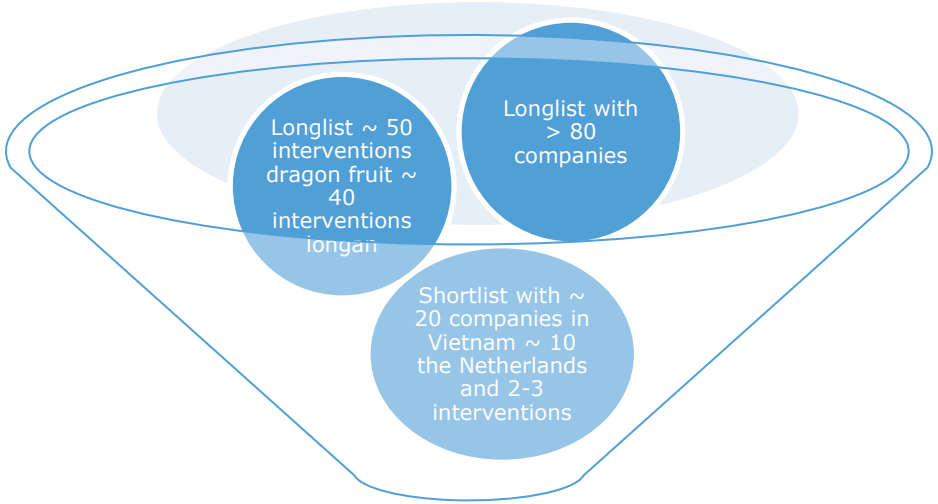
Approach dragon fruit:

- 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

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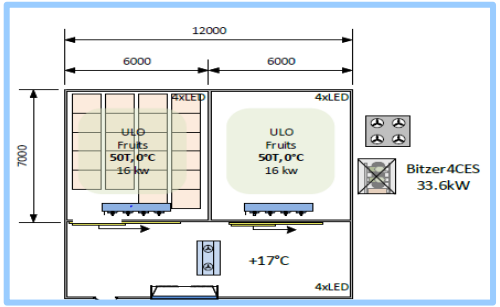
4.3 From longlist to shortlist of interventions and stakeholders

EU organic farming logo

Interviews in the Netherlands

In general interested in this project but mainly in dragon fruit

- 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



4.3 From longlist to shortlist of interventions and stakeholders

Result

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

Interesting opportunities for both countries

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

Limited opportunities for both countries

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

https://www.nuffic.nl/en/subjects/orange-knowledge-programme

https://landwaterfood.com/news?news_id=522083

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

Lead time (Day number)	1				5	7		10
Current situation (Price VND/EUR kg)	10,000/ 0.36		13,500/ 0.49		157,000/ 5.70	83,000/ 3.00*	248,000/ 9.00	414,000/ 15.00
Future scenario (Price VND/EUR kg)					33,000/ 1.20	83,000/ 3.00	124,000/ 4.50	207,000/ 7.50

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

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)

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*prices pre-covid

4.4c Pros and cons supply by sea from Vietnam to Europe

Lead time (Day number)**	1				5	26-27 (Covid +~5)		29
Current situation (Price Dong/EUR kg)	10,000/ 0.36		13,500/ 0.49		157,000/ 5.70	2200/ 0.08*	248,000/ 9.00	414,000/ 15.00
Future scenario (Price Dong/EUR kg)					83,000/ 3	2200/ 0.08	124,000/ 4.50	207,000/ 7.50

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

No	Scenario	Food Losses from harvest to importer in Rotterdam per ton	Greenhouse Gas Emissions from harvest to importer in Rotterdam
1	Current supply chain: from Mekong Delta – HCMC – Rotterdam (by air)	(total estimated at 0.15 tons)	26.5 kg CO2-eq. per kg product
2	Current supply chain from Mekong Delta – HCMC – Rotterdam (by sea)	0.44 tons	23.7 kg CO2-eq. per kg product
3	Future scenario, improved supply chain 70 % loss reduction from producer to wholesaler, standard <7% importer : from Mekong Delta – cooling – HCMC – Rotterdam (by boat)	0.13 tons	16.1 kg CO2-eq. per kg product

4.4d Scenario comparison of Food Loss & Waste-Greenhouse Gas Emissions

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

ACE calculator
Agro-Chain greenhouse gases Emissions Calculator

Jan Broeze
Wageningen Food & Biobased Research
Version 19 May 2021

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Case/scenario title:	Scenario 1. Dragon Fruit Vietnam - Europe: Air transport	Scenario 2. Dragon Fruit Vietnam - Europe: Sea transport	Scenario 3. Dragon Fruit Vietnam - Europe: Sea, reduced loss
Marketed food product CLIMATE IMPACT	*26.49 kg CO2-EQ. per kg sold on market*	*23.67 kg CO2-EQ. per kg sold on market*	*16.09 kg CO2-EQ. per kg sold on market*
FOOD LOSS (lost edible part)	*15.36%*	*44.00%*	*13.08%*
FOOD LOSS ASSOCIATED GHG EMISSIONS	*2.62 kg CO2-EQ. per kg sold on market*	*10.36 kg CO2-EQ. per kg sold on market*	*1.95 kg CO2-EQ. per kg sold on market*

Summary of climate impacts results

Overview of climate impacts per chain stage	*Direct emissions*	*FLW-associated*	*Total*	*Direct emissions*	*FLW-associated*	*Total*	*Direct emissions*	*FLW-associated*	*Total*
Harvesting and on-field post-harvest operations	12.870	1.510		12.870	1.510		12.870	1.510	
(On-farm) Transport	0.000			0.000			0.000		
Postharvest handling and storage (on-farm)	0.000	0.000		0.000	0.000		0.000	0.000	
Transport	0.000			0.000			0.000		
Processing and Packaging	0.000	0.445		0.000	0.445		0.003	0.219	
(Possibly international) Transport	11.003			0.443			1.262		
Processing/repackaging/distribution	0.000	0.662		0.000	8.403		0.000	0.225	
Distribution transport	0.000			0.000			0.000		
Market/Retail shop	0.000	0.000		0.000	0.000		0.000	0.000	
TOTAL (incl. correction for moisture and residues loss	*23.873*	*2.617*	*26.490*	*13.313*	*10.358*	*23.671*	*14.136*	*1.954*	*16.090*

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

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4.5 Investment space for food losses reduction

	Export to China		Export to EU	
Stakeholder	Weight loss/ton	Value loss/ton	Weight loss/ton	Value loss/ton
Farmer	≈0.1 tons	1.7 MVND* / 62 €	≈0.1 tons	1.7 MVND / 62 €
Trader	0.02 tons	1.2 MVND / 44 €	0.02 tons	1.2 MVND / 44 €
Wholesaler	0.02 tons	1.3 MVND / 47 €	0.02 tons	1.3 MVND / 47 €
Exporter (road)	Negligible	0.38 MVND / 14 €		
Exporter (sea)			0.3 tons	20.4 MVND / 740 €
TOTAL	0.14 tons	4.58 MVND / 166 €	0.44 tons	24.6 MVND / 893 €

*MVND = Million VND

Production per year/farmer on average = 30 tons

Food loss savings potential 30 x 0.1 tons =3 tons/year = 30 Million VND/year (1090 €)
Value loss savings potential 30 x 1.7 = 51 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)

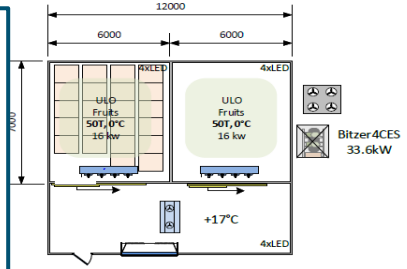
4.6 Intervention based on investment space

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

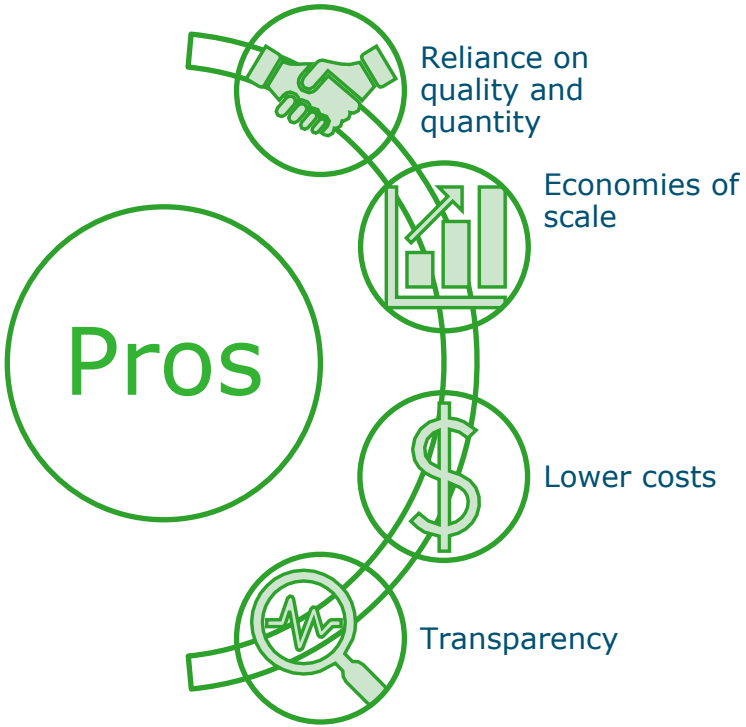
	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov
Raining Season												
Main harvest												
Minor production season												
Export window Spain/ Morocco												
Opportunity window for export to Europe		Most interesting short term				Further research needed*			Further research needed*			

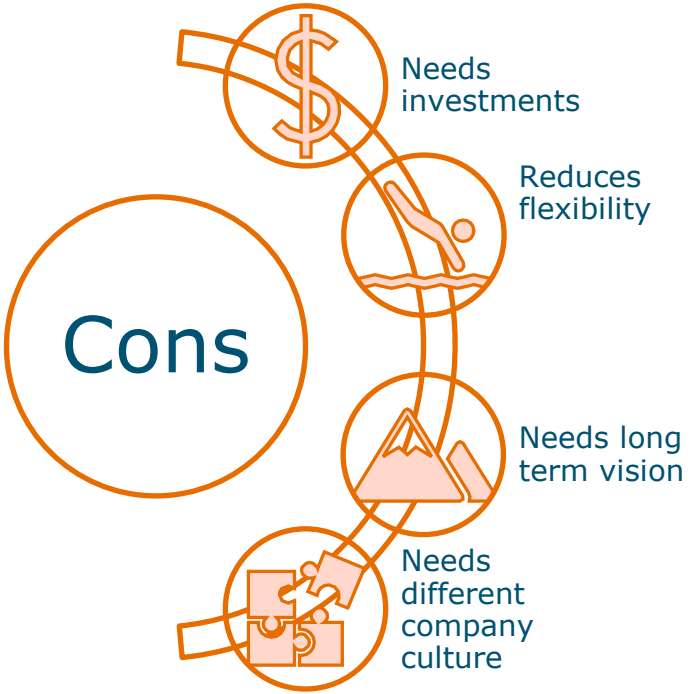
Not applicable

Period

*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





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

Type of Company in the Netherlands	Relevant services of Dutch company	Main pre-conditions of Vietnamese company
Importer of dragon fruits	Import and distribution in Europe, market development, increase of dragon fruit sales	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
Logistic service providers, warehouse services	Logistic services from door to door, warehousing, packaging, support with import	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
Cold storage facilities	Tailored high-tech cold storage facilities, 24/7 service	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
Bank	Access to finance for cold storage facilities or other hardware, understanding of the agro business	Bankable business plan with a good return of investment, guaranties, account statement/positive financial balances of the previous years

* 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)*

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5. Main conclusions, recommendations, phases, outlook

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'

Ambition

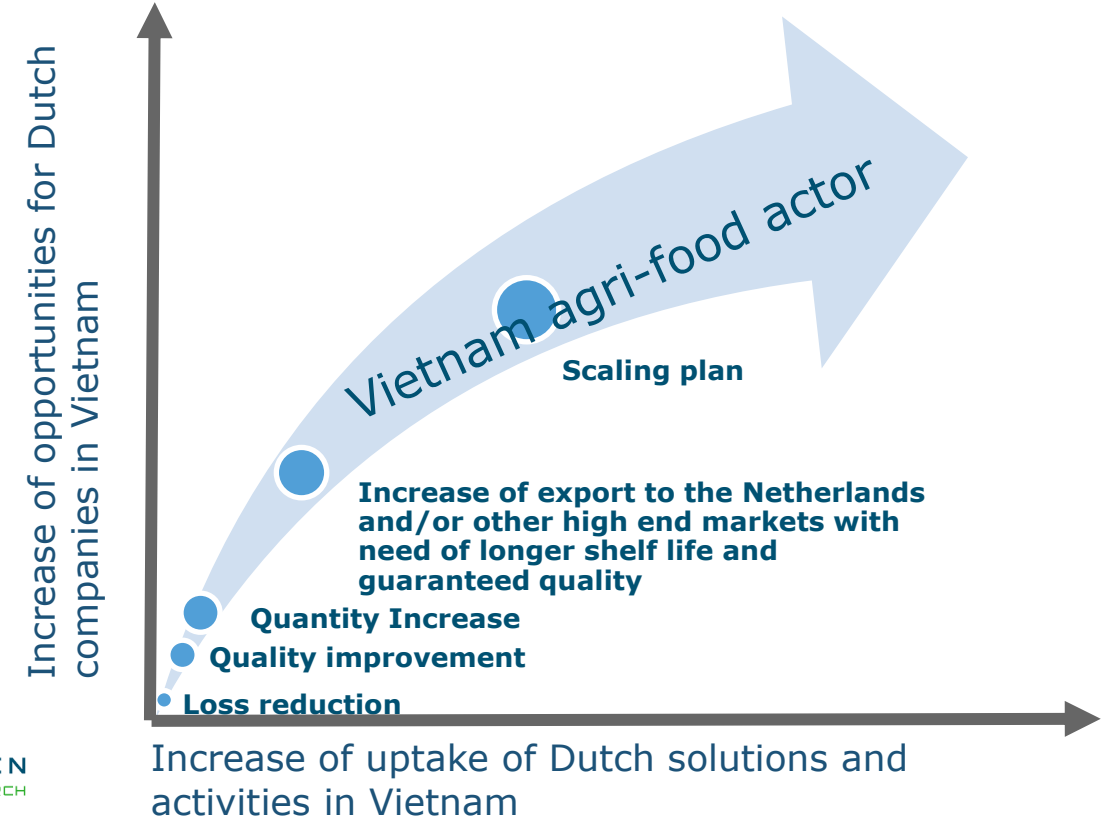
Phase 3: Innovative coalition for change, 3-4 years project

Aim (2022-2025)

- Design of 1-2 improved supply chains
- Train
- Implement
- Pilot/Test
- Scale... so on

5. Main conclusions, recommendations, phases, outlook

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



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Let that be the beginning of a fruitful collaboration on Food Loss and Waste reduction and new business opportunities

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