NATSURV 19

WATER AND WASTEWATER MANAGEMENT IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY

GreenCape Seminar

15 February 2022

GreenCape

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Road map

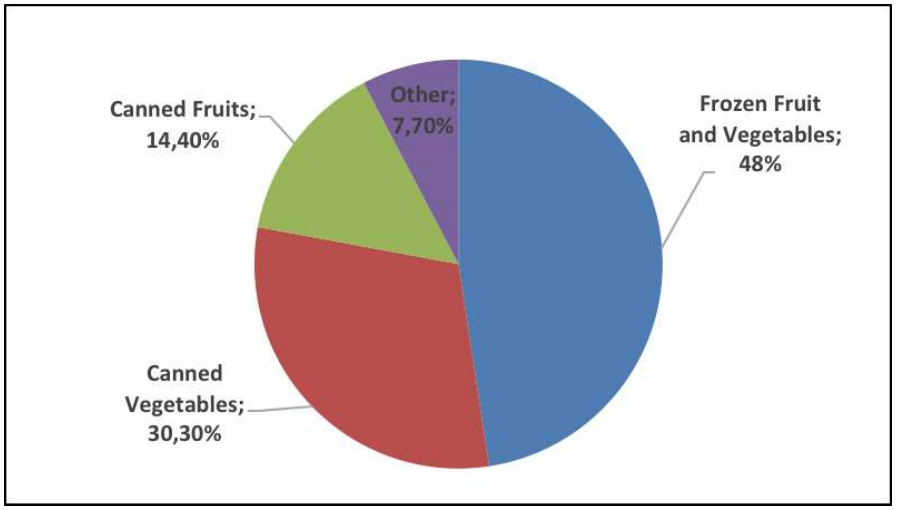
Overview

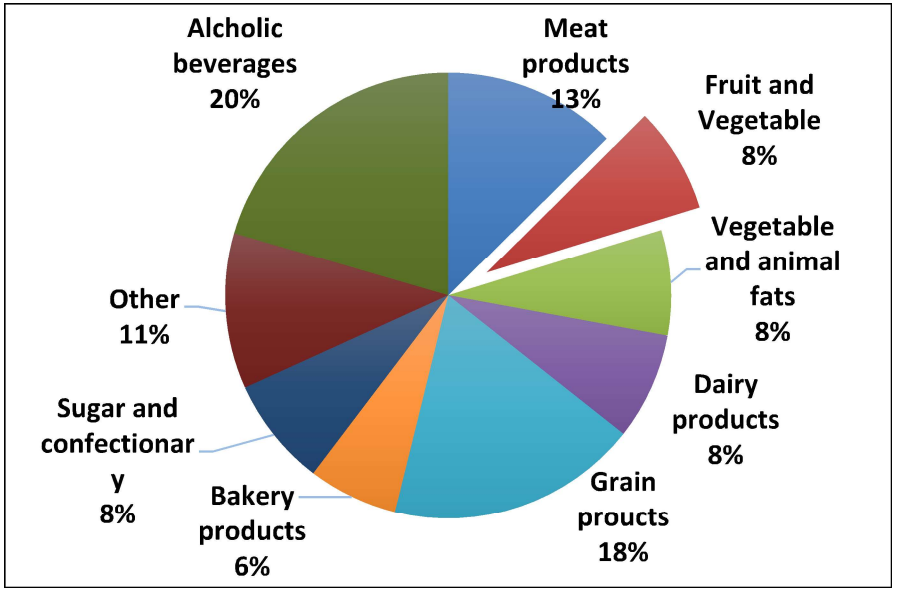
- Background
- Water use
- Wastewater management
- Key findings
- Recommendations

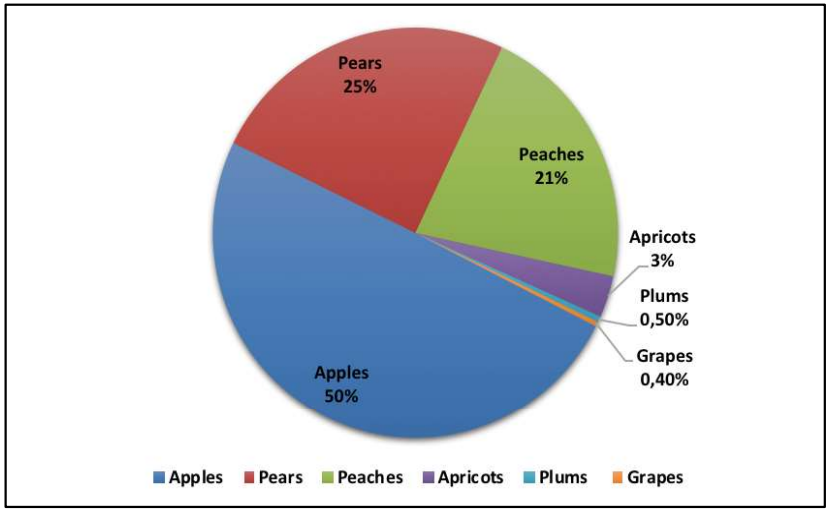
Aims of the NATSURV 19 (FVPI) project

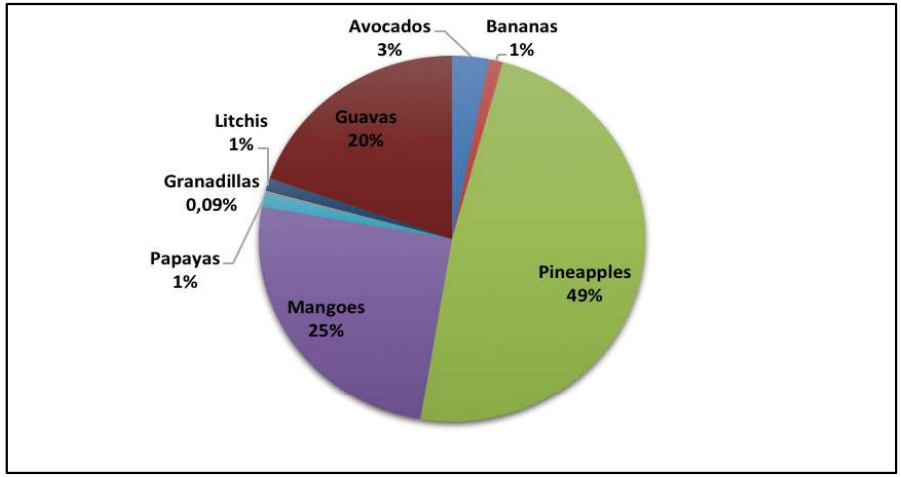
- Overview of the local fruit and vegetable processing industry
- Evaluate and document the 'generic'" industrial processes in terms of:
  - current practice
  - best practice and
  - cleaner production
- Determine water consumption and SWI
- Determine wastewater generation and pollutant loads
- Determine local municipal tariffs and by-laws
- Evaluate water and wastewater management procedures
- Summarise findings, guidelines and best practices

Segmentation of Fruit and Vegetable Processing

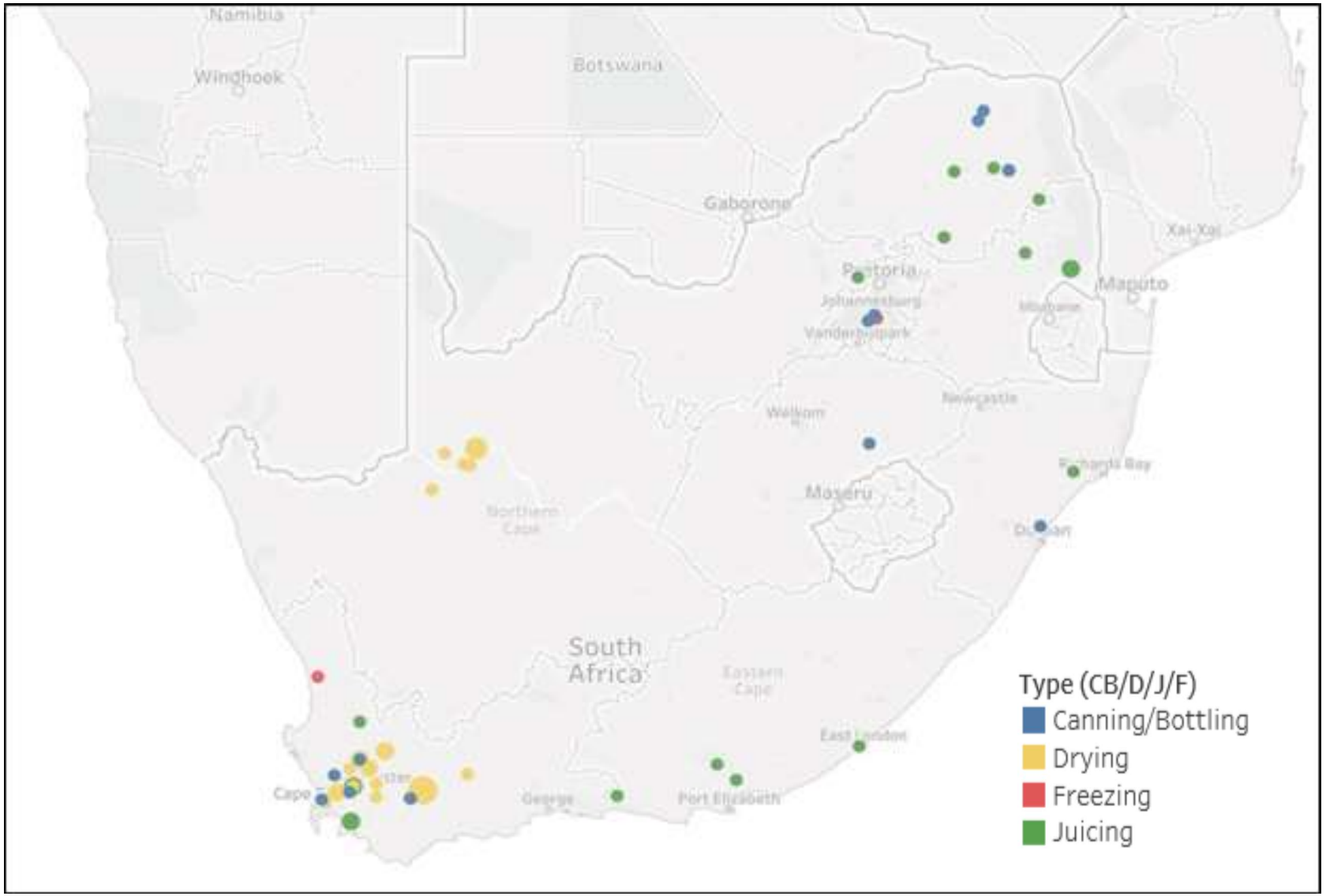




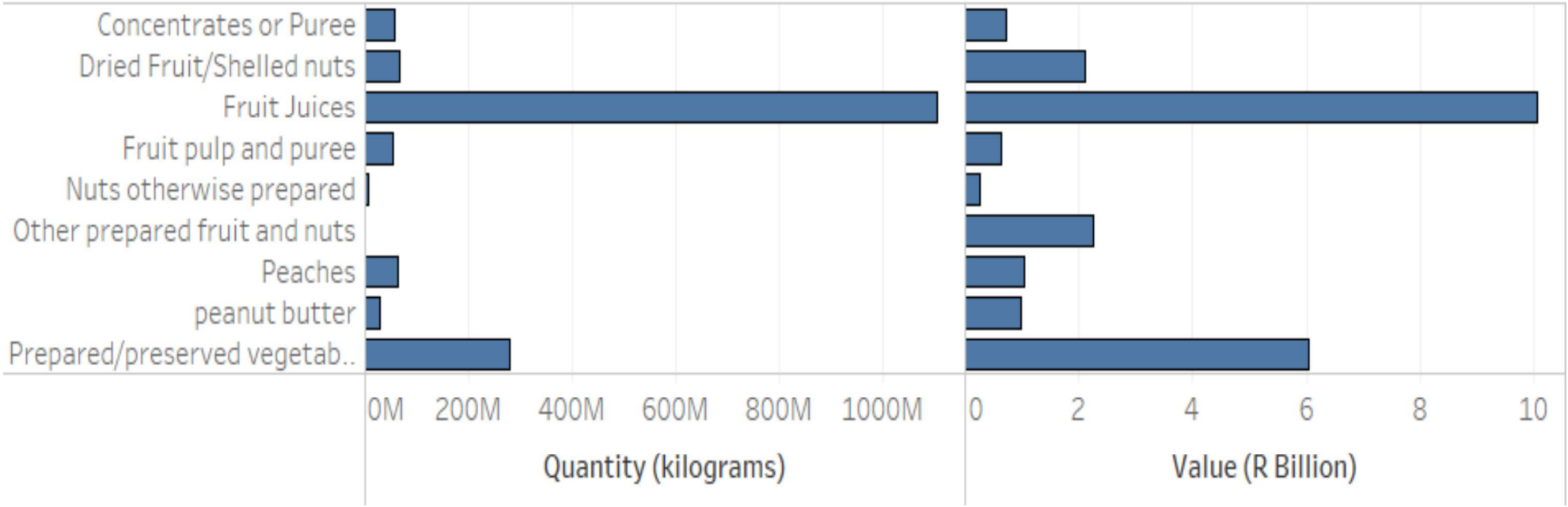




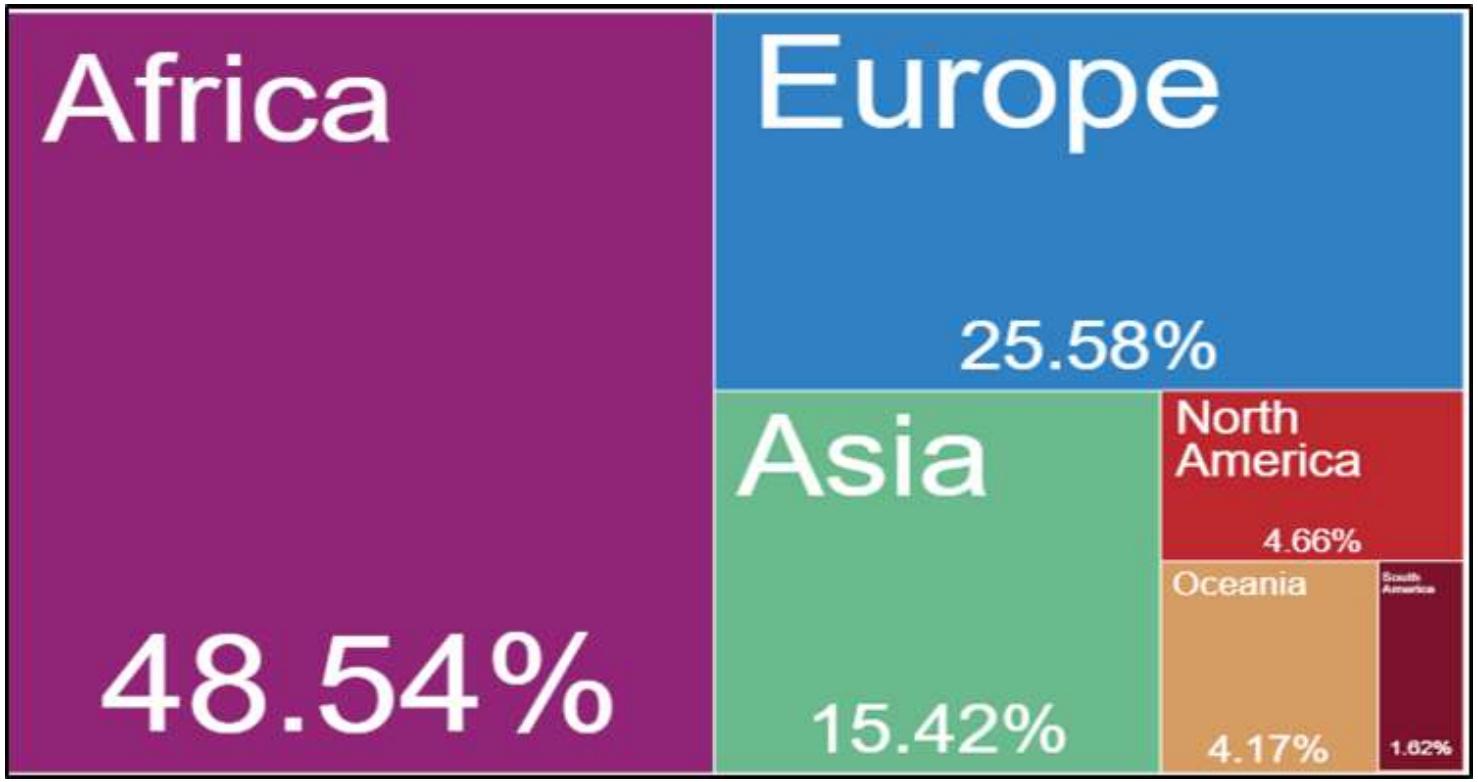
Locations of processing facilities in South Africa



Specifics in the FVPI



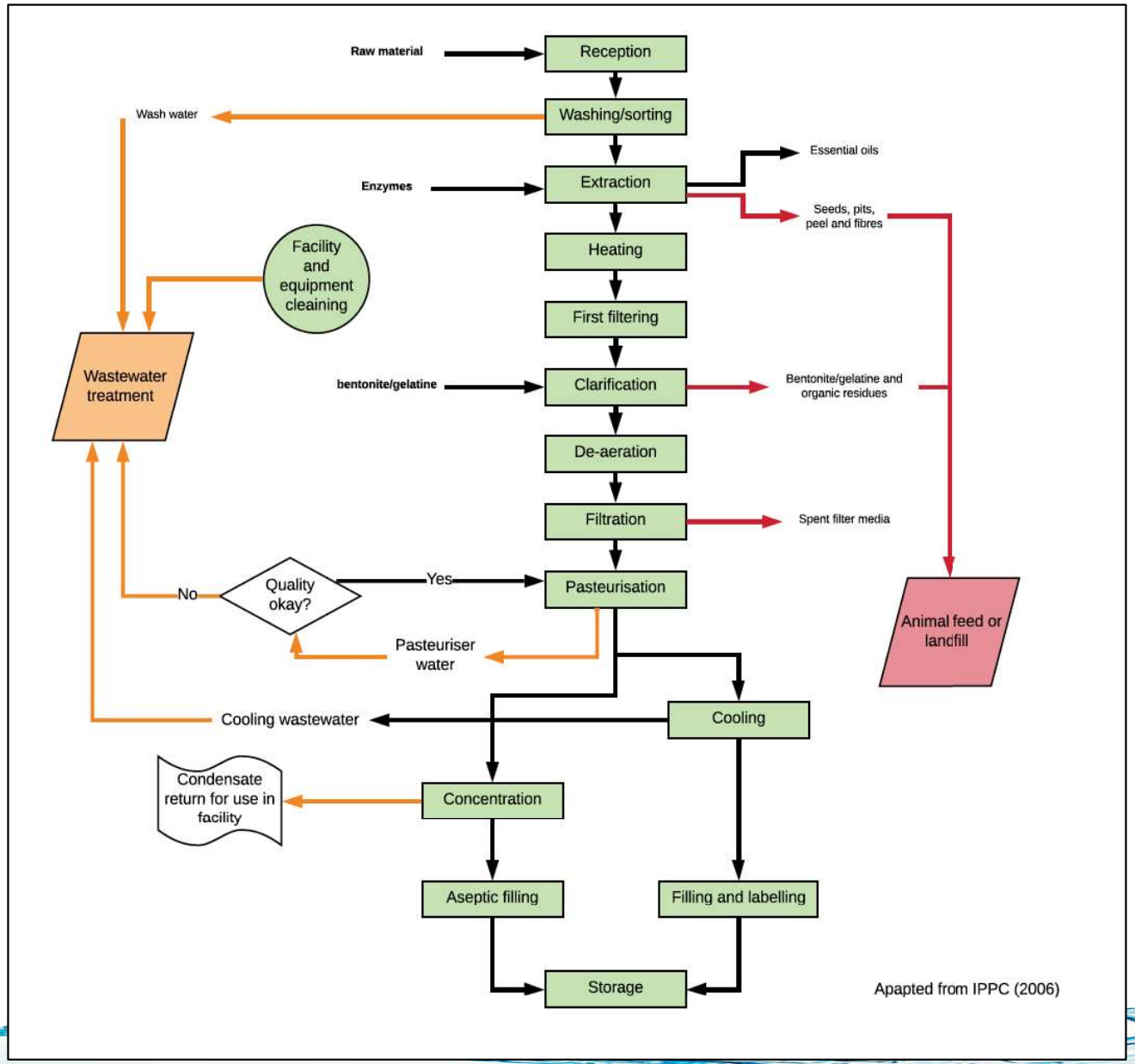
Export Destinations for Fruit and Vegetable Products in 2016 (CID, 2018)



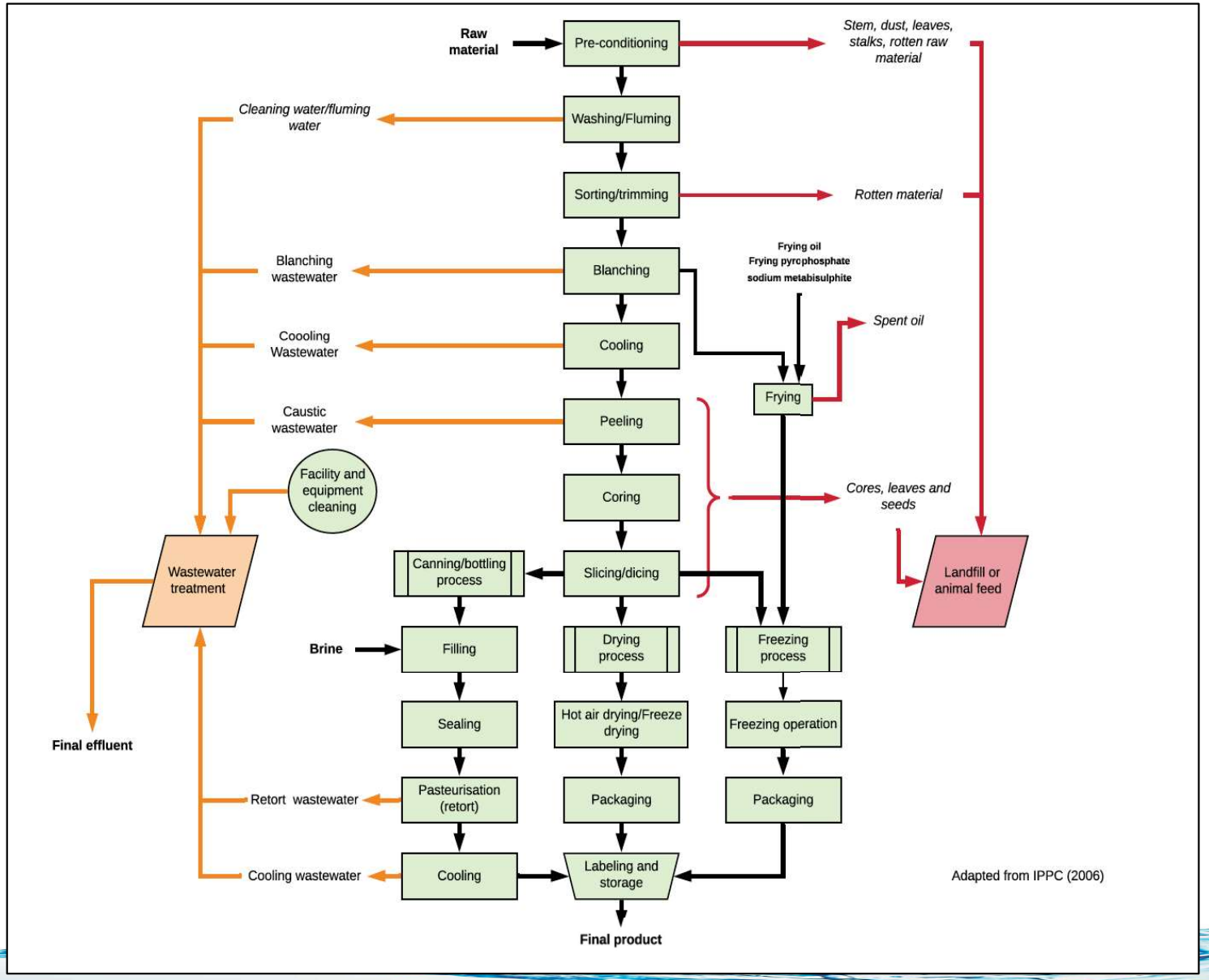
SWOT analysis of the South African FVPI (Bekker, 2018)

Strengths	Weaknesses
• Well established international trade network • Increasing processing capacity • Counter seasonality to export destinations • Proximity to African export markets • Industry has been targeted for governmental support	• Substantial barriers to entry • Susceptible to drought and fluctuations in horticultural yield • Profitability very dependent on exchange rate • Consumer spending constraints may lead to substitution with fresh produce • Increasingly concentrated and mature sector
Opportunities	**Threats**
• Increasing export opportunities, especially Asia • Increased regional demand for processed fruits and juices • Potential support from government in the form of funding and linkage schemes	• Slow economic growth and high unemployment will pressure consumer spending • Drought and water shortages • Rising input costs (including labour, energy and fuel) • Sugar Beverages Levy (SBL) (Health Promotion Levy) • Carbon tax • Concerns over expropriation without compensation

Process flow diagram for juicing industries



Process flow diagram for the canning, freezing and drying industries



Study by DEDAT

DEDAT / OABS Report (2019)

(Optimal Agricultural Business Systems)

Development of a programme to improve the economic water resilience of the agro-processing sector (with further detail for sub-sectors: Fruit and Vegetables and Dairy) in the Western Cape

Report on water risks, challenges and impacts across the agro-processing sector and sub-sectors Fruit and Vegetables and Dairy

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Site visits and obtaining information

Outputs of site visits

14 Site Visits in total:

First 5 factories - **field notes**

Remaining 9 - **recorded interviews**

Photographic evidence

- 5 in Western Cape
- 4 in Eastern Cape
- 1 in Gauteng
- 1 in Mpumalanga
- 3 in Limpopo

Figure 5.4: Anaerobic lagoons used at facility 3103.2

Figure 5.5: Aerobic lagoons (with aerator) used at facility 3103.2

Figure 5.6: Inlet to settling dams at facility 3013.5 (Angle 1)

Figure 5.7:Settling dams with moving screen filter at facility 3013.5 (Angle 2)

Annual water consumption and production at facility 3013.8

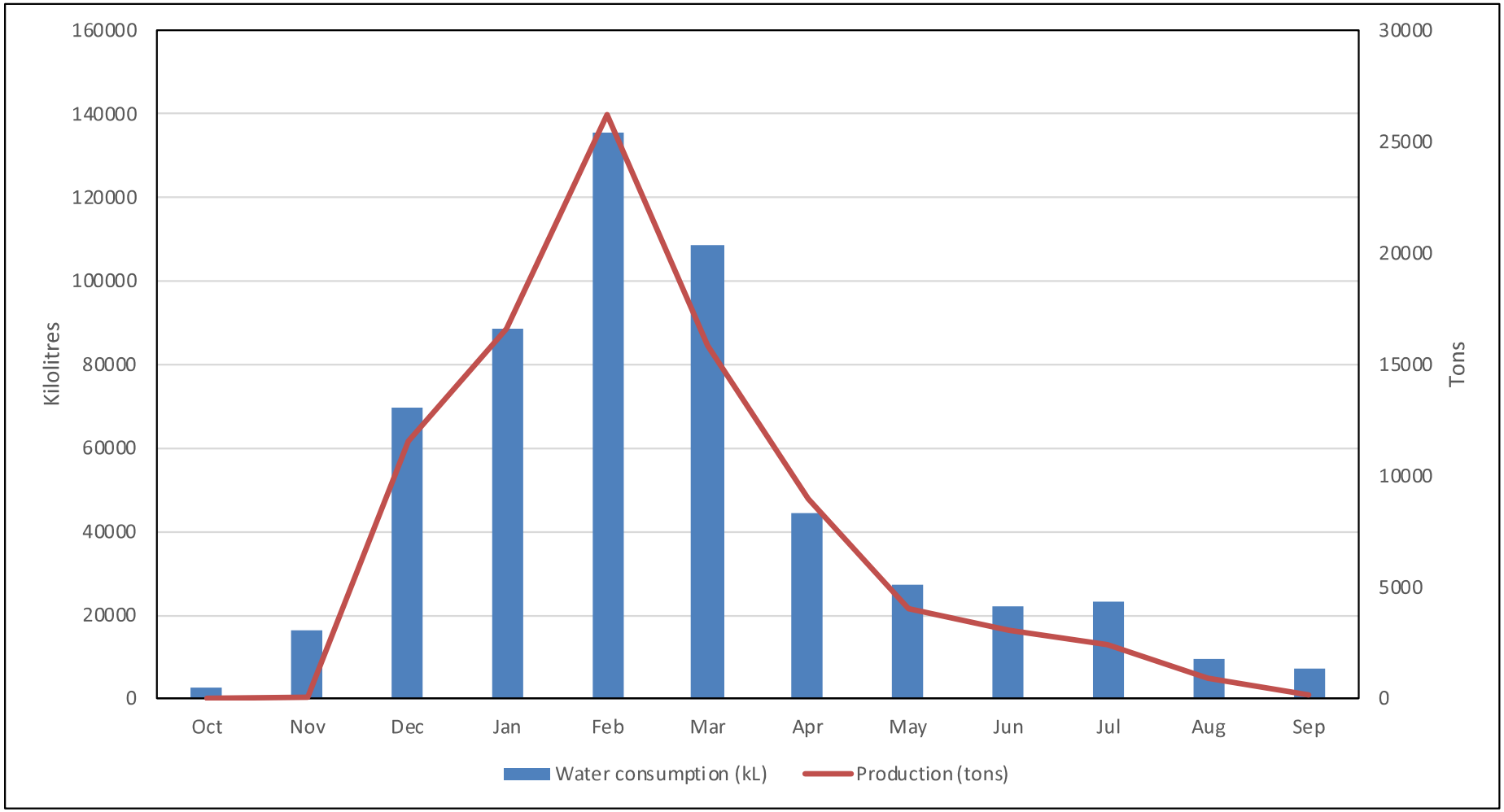

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Figure 5.10: Industrial raw material washing at industrial unit 3013.9

Facility 3013.12 removed the ‘dumper baths’ and now loads fruit directly onto conveyer belts

Interesting observations

Water Consumption and Specific Water Consumption Results

Water Consumption and Specific Water Consumption Results

Facility	Main products	Fresh water consumption (m^3)	SWI (m^3/ton product)	SWI (m^3/ton product) according to literature
3013.9	Frozen potato products	560 p/d 143 018 p/a	6,2	Frozen fruit/vegetables (USA): 9,4 Frozen vegetables (EU): 6,75
3013.10	Canned vegetable products	14 400 p/a	1,6	Canned vegetables (EU): 4,75 Canned tomato (USA): 2,93
3013.11	Frozen vegetables	188 976 p/a	3,3	Frozen fruit/vegetables (USA): 9,4 Frozen vegetables (EU): 6,75
3013.12	Canned/bottled picante peppers and other vegetables	300 p/d 78 545 p/a	19,2	Canned vegetables (EU): 4,7 Canned tomato (USA): 2,93
3103.13	Deciduous fruits and vegetables	553 824 p/a	6,16	Canned Oranges (China): 30 Canned Fruit (USA): 5,8 Canned Fruit (EU): 3,25 Canned vegetables (EU): 4,75
3013.14	Tree fruits	60 p/d	15	Dehydrated fruit (USA):0,3
3013.16	Apples concentrate	74 213 p/a 1 650 p/d	4,8	Fruit Juice (EU): 6,5 Fruit Juice (UK): 3,5
3013.17	Pineapples concentrate	101 164 p/a	10,15	Fruit Juice (EU): 6,5 Fruit Juice (UK): 3,5
3013.18	Canned peppers and vegetables	17 700 p/a	5,9	Canned vegetables (EU): 4,7

Physiochemical characteristics of different effluent streams in the FVPI

(Valta et al., 2017; Guzmán et al., 2016; Amor et al., 2012; El-Kamah et al., 2010; Şentürk et al., 2010)

Processing type	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	pH
Tomato processing	500	1500	400	6.5-8
Fresh and frozen peaches/apricots	1100	2300	900	-
Peach and apricot compote	1300	1800	460	-
Canned and pureed peaches/apricots.	1750	3500	500	7-8.5
Canned and pureed peaches/apricots	1200	4000	800	6-8
Citrus juice	6619	10019	777	3.8
Fruit juice	1289	5157	323	-
Citrus concentrate	13900	21040	3130	3.45
Potato processing	4000-5000	5250-5750	2000-2100	7-8

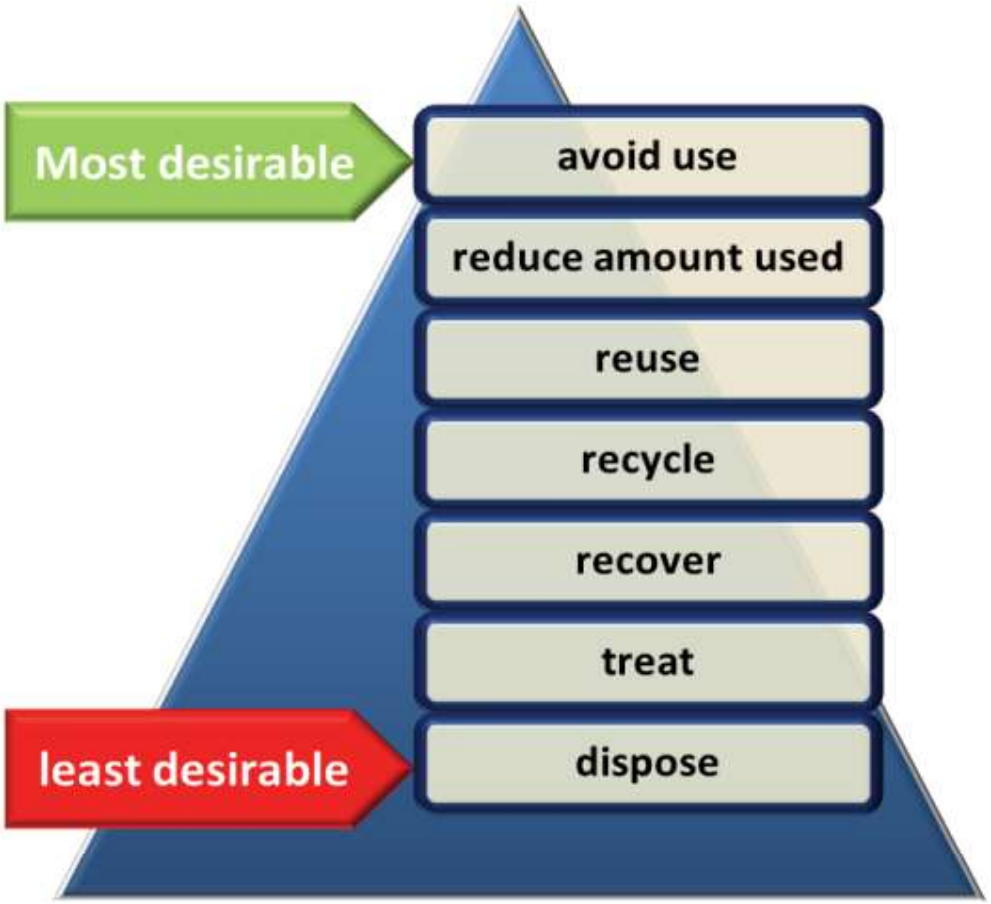
Energy Saving Techniques in the FVPI

Process	Energy saving technique
Blanching	Heat recovery from blancher water or condensate via a heat exchanger
	Upgrading of steam blanchers to modern units with energy efficient features (e.g. steam seals)
	Heat and hold techniques instead of continuous subjection to heating medium
	Steam recirculation
Dehydration/drying	Use of direct fired dryers
	Proper and timely maintenance
	Insulation of any hot surfaces on dryer that are exposed to outside air
	Mechanical dewatering of fruit and vegetables prior to drying
	Process control for optimisation of energy inputs
	Using dry air to reduce the amount of energy required to heat and vaporise any incoming moisture
	Heat recovery from product where it is deliberately cooled after drying

Energy Saving Techniques in the FVPI

Process	Energy saving technique
Evaporation	Proper and timely maintenance of evaporator
	Use of multiple effect evaporators
	Mechanical or thermal vapour recompression (potentially more effective than multiple effect evaporators)
	Freeze or membrane concentration
Frying	Heat recovery via adsorption cooling
	Heat recovery via exhaust gas combustion
	Using spent fryer oil as fuel
	Heat recovery from fryer exhaust gases
	Heat recovery via adsorption cooling
Pasteurisation and sterilisation	Insulation of all hot surfaces in contact with external air
	Use of helical heat exchangers
	Induction heating of liquids
	Compact immersion tube heat exchangers

Best practice hierarchy - towards a sustainable future



Key findings of NATSURV 19 on the FVP industry

- Strong export orientated approach to production
- Focus specifically on intra-Africa trade
- Highly competitive and concentrated nature
- Few key players accounting for large portions of both production and employment
- Locations of processing facilities generally determined by the proximity of the raw inputs, with only a few exceptions
- Western Cape was found to be the leading host of processing facilities, with a heavy focus being placed on the juicing and canning of deciduous fruits
- Eastern Cape, Northern Cape, Limpopo and Mpumalanga provinces forms the other concentration points
- Some of the facilities reported SWI figures comparable or better than that of their international counterparts

Key findings of NATSURV 19 on water use

- Many of the facilities have dedicated long term strategies for improving water use
- Raw material and facility cleaning were found to be the main consumers of water
- Initial water saving endeavours should be directed at these operations
- Improvements in water efficiency in the South African FVPI are not only motivated by desire for environmental protection or drought risk, but also for financial reasons
- Costs of water consumption and effluent disposal can be reduced by improving the water efficiency of the processes.

Key findings of NATSURV 19 on wastewater management

- With regard to wastewater management, it can be concluded that advanced treatments are not generally practiced within the industry
- Most facilities perform at least a primary wastewater treatment
- Less motivation for facilities to invest in secondary treatments, possibly due to the lengthy pay-back periods associated with the capital expenditure
- Only three facilities of the 19 included in the final sample practiced advanced/tertiary treatment
- Rural settings most commonly choose irrigation as the preferred disposal route
- Urban environments provided the means for municipal wastewater systems.

Water saving recommendations

- **Pressure reduction** at handwashing stations
- **Elbow/knee operated** water distribution points
- Reducing the **frequency of washing of employee coats**
- Installation of a **ring main** water distribution system and **central shutoff valves in each area**
- **Solenoid valves** to automatically shut off water supply
- **Recirculation of boiler water**
- **Etc**

Process Control for Optimal Water Use

Technique	Description
Use automated stop/start controls	Sensors can detect the presence of raw materials and only supply water when it is required. Water supplies can be turned off automatically during production stoppages and product change-overs.
Use of control devices	Valves are the most common control devices and their implementation can reduce water consumption and associated energy requirements
Use of water nozzles	Water consumption and wastewater generation can be reduced by correctly positioning and directing nozzles. Presence-activated sensors, and only installing nozzles where required can also ensure that water is only used when and where necessary
Use automated stop/start controls	Sensors can detect the presence of raw materials and only supply water when it is required. Water supplies can be turned off automatically during production stoppages and product change-overs.
Use of control devices	Valves are the most common control devices and their implementation can reduce water consumption and associated energy requirements

Recommendations

Interventions proposed by stakeholders

A number of interventions were proposed in the OABS report (OABS, 2019):

- Public perceptions on the re-use of waste water within the food industry should be changed through education and capacity building to create an understanding of the safety of re-use systems.
- Water augmentation options should also include desalination of sea water, the development of groundwater resources and the re-use of treated effluent to create increased resilience.
- Improved maintenance of bulk water infrastructure by local authorities is required to reduce losses in water supply systems.
- Water savings incentives/financial support from local authorities/government are required to support agri-businesses to embark on water saving initiatives.

Recommendations

- Agri-processing companies can sponsor water efficient appliances/technologies for their staff to implement at their houses. Some companies support their staff by providing information but not appliances.
- Metering of water right through all the agri-processing phases should be standard practice as it can indicate critical areas where water savings can be achieved
- Water audits can assist to increase their water use efficiency. The Centre, South(NCPC-SA) continues with the drive to raise awareness in industry and government about the importance of water management. Through their Industrial Water Efficiency (IWE) Project, companies can apply for free water assessments and assistance with implementing water efficiency in their plants (Engineering News, 2018).

The way forward: focus areas

A number of aspects affecting the FVPI in South Africa need to be addressed to ensure the competitiveness of the local industry in world markets. Some of these include:

- impact of the COVID-19 pandemic
- local and global pricing pressures
- water scarcity during periods of droughts
- impact of poor economic periods on the industry
- export regulations
- changing consumer trends.

The way forward: focus areas

Regarding water and wastewater management in these industries in particular, the challenges for the producers include:

- water availability (especially during periods of water scarcity)
- water quality
- Because of the high water quality requirements for food industry process water, water recycling presents a number of challenges when considering this as options to reduce the fresh water intake to the industries. **There is a big need for further research on this and related topics.**

Other opportunities for further research and project development include:

- the improvement of licencing processes
- improved cooperation between the different government tiers
- making more use of groundwater rather than surface water
- improvement of sensing and flow measurement technologies
- establishing effective partnerships.

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