



*Tom Bastiaansen, Elisa Bongiolatti, Anouk van Hout,
Marit Meinsma, Harmske Schellekens and Yujie Wang*

Food for feed: Quantitative and Qualitative Analysis of Food Byproduct Streams for Livestock Nutrition in Singapore



We have
addressed

The playing field of Singapore

Legislative opportunities

Livestock production

Food industries

5.6 million people on 716 km²

GDP Capita⁻¹ = 93,905 USD



Connection with foreign countries



Innovative infrastructure



Private sector participation



Food import

Food waste

Import rate of
90%

Highly
dependent on
other countries

809,800 tonnes
in 2017

Recycling rate of
16%

Limited farming
land and fishing
grounds

The playing field of Singapore



“geographic concentration of interconnected companies, specialized suppliers, service providers and firms in related industries, and associated institutions in particular fields that compete but also cooperate”

Urban Food Cluster Singapore

Legislation in Singapore

- National Environment Agency (public health and sustainability) and Agri-Food & Veterinary (Animal health) and the Health Sciences Authority
- April 1, 2019, 'The Singapore Food Agency'
- Reactive nature of government: Minister clause
- Existence of business with comparable work?



Legislation Neighbours Malaysia and Indonesia

- In both countries, a bit more extensive regulation
- Pre-existing regulations on food byproducts in animal feed is non-existent in Malaysia and government: reactive character and will judge on a case-by-case basis
- Indonesia: more extensive rules and regulation, ministry of Agriculture, feed needs to be registered
- Generally speaking, Dutch legislation is way more extensive

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Prime examples Japan & South-Korea

Japan: law that prioritizes creation of ecofeed
52% is recovered into animal feed ...
... 93% pre consumer industry
...16% post consumer industry

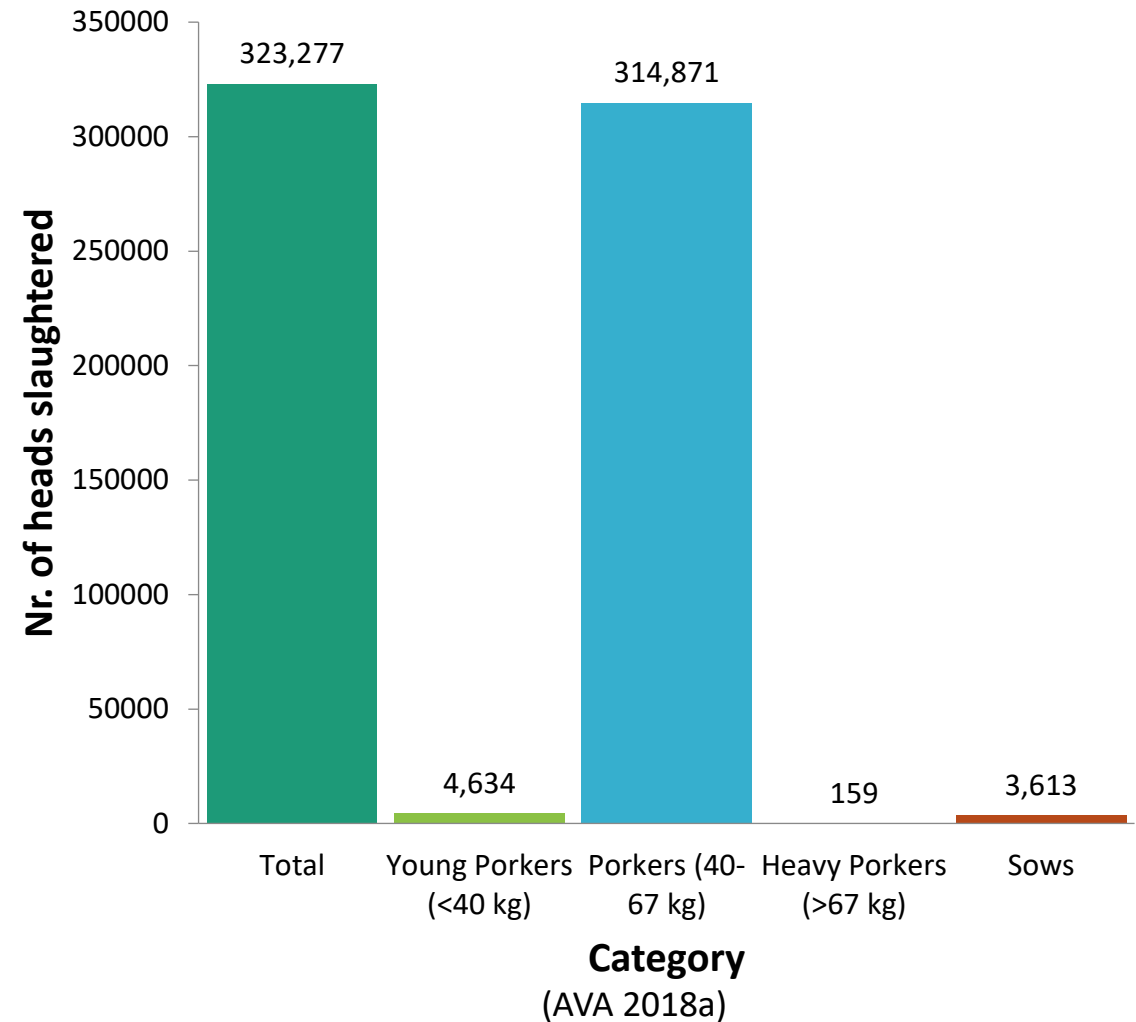
South-Korea: **42.6%** of total food waste processed
into animal feed

Livestock - Swine

“Pork is the red meat of choice for many Singaporeans.” (AVA 2017)

- Import of live animals from Malaysia and Indonesia
- No market for pig feed in Singapore

Swine slaughtered in 2017 (number of heads)



Livestock - Poultry



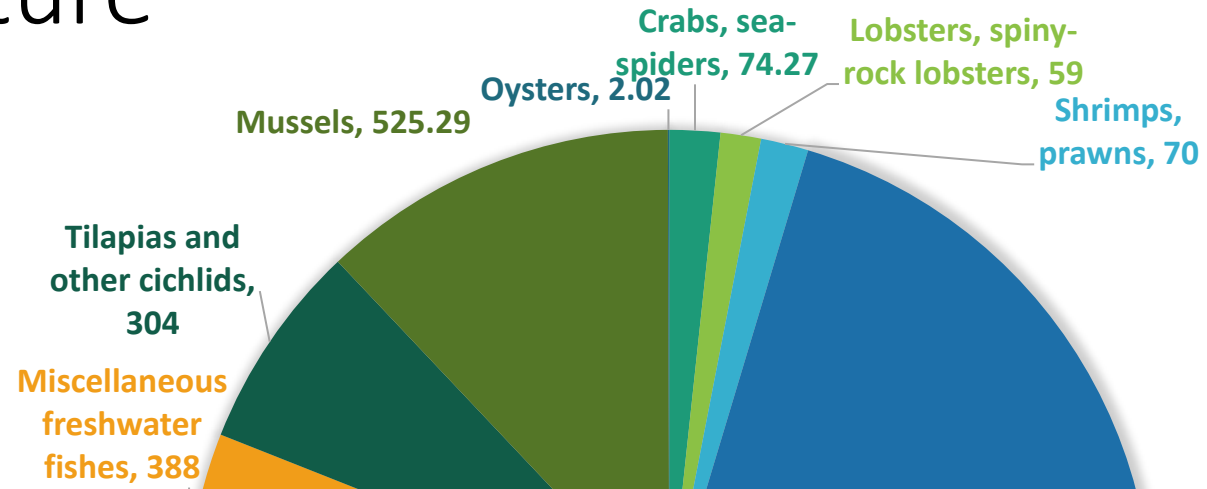
(AVA 2018b, AVA 2018c, AVA 2018d)

Livestock - Aquaculture

- Small fishery sector, so most fish is imported
- Ornamental fish production
- Fast development
- Recirculating Aquaculture System (RAS)



QUANTITY OF SEAFOOD PRODUCED IN 2016 (TONNES)



Carps and cyprinids

Carps and cyprinids, 2,941

(FAO 2019)

Supply – The food industry

Food byproducts are products besides the main food products, resulting from food production or food procession, unsuitable or undesirable for human consumption

- Dense food industry
 - 233 manufacturers
- Two types of byproducts:
 - Pre-consumer byproducts (industry- and retail level)
 - Post-consumer byproducts (household, restaurant, and catering level)
- Legislation & Food Safety

Supply – Estimation of industrial byproducts

Food by-products	Estimated Quantity	Unit of measure
Cocoa shell powder	790.5	tonnes
Fish byproducts	38,980	tonnes
Malt spent grains	378.3	1000 MT
Palm oil sludge	2.1	1000 MT
Soybean byproducts	86.2	1000 MT
Trimmings of raw noodles	2920	Tonnes
Wheat byproducts	67.7	1000 MT

Based on data of (FAO 2000; USDA 2019)

Conclusion

- Conceptually interesting
 - Sustainability initiatives
 - Infrastructure
- Considerations
 - Small national livestock sector
 - Feed price unknown
 - Legislation
- Further investigation in economic feasibility is required

Implications

- Quality analysis
 - Nutritional quality of byproducts
 - Consistency of supply
- Economic analysis
 - In-depth investigation of price
 - Assessment of the market
- Use local contacts
- Be sensitive to governmental developments

References



- AVA (2017). "Diversifying Singapore's sources of fresh pork." AVA Vision 3-4. Retrieved 28/2/2019, 2019, from https://www.ava.gov.sg/files/avavision/issue3_2017/diversifying-singapore-sources-of-pork.html.
- AVA (2018a). Livestock Slaughtered - Pigs. A.-F. V. A. o. Singapore. Singapore, Government of Singapore.
- AVA (2018b). Livestock Slaughtered - Chickens (Breakdown). A.-F. V. A. o. Singapore. Singapore, Government of Singapore.
- AVA (2018c). Livestock Slaughtered - Ducks. A.-F. V. A. o. Singapore. Singapore, Government of Singapore.
- AVA (2018d). Livestock Slaughtered - Quails. A.-F. V. A. o. Singapore. Singapore, Government of Singapore.
- Ecowise (2018). Annual Report 2018. Singapore, Ecowise: 15.
- FAO, S. D. (2000). Item Trees. Technical conversion factors for agricultural commodities, Food and Agriculture Organization of the United Nations: 722-782.
- USDA (2019). "Index Mundi - Singapore." Retrieved 28/02/2019, 2019, from <https://www.indexmundi.com/agriculture/?country=sg&graph=production>.