The Role of Cattle as Up-cyclers of By-products and Food Waste

Kim Ominski, Tim McAllister, Kim Stanford, Genet Mengistu, E G Kebebe, Faith Omonijo, Marcos Cordeiro, Getahun Legesse, Jaime White, Karin Wittenberg

WESTERN CANADA FEEDLOT MANAGEMENT SCHOOL

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FIAT LUX

Growing Global Demand for Foods of Animal Origin

Opportunity:

- Increase in exports for Canada

Challenges:

- Finite resources to expand production
  - Land conversion from perennial to annual crops
  - Urban encroachment into farmland
  - Climate change – extreme weather events leading to decreased feed quality and quality
- Public trust
  - Impact of livestock on the environment

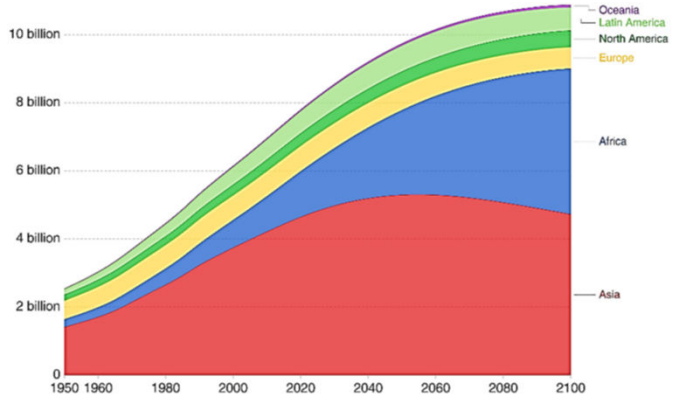

Fig. 1. World population by region projected to 2100, based on the United Nation's medium population scenario (Roser et al.2019).

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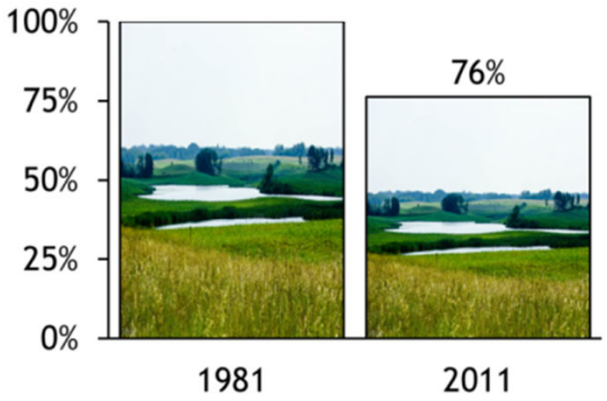
Environmental Footprinting

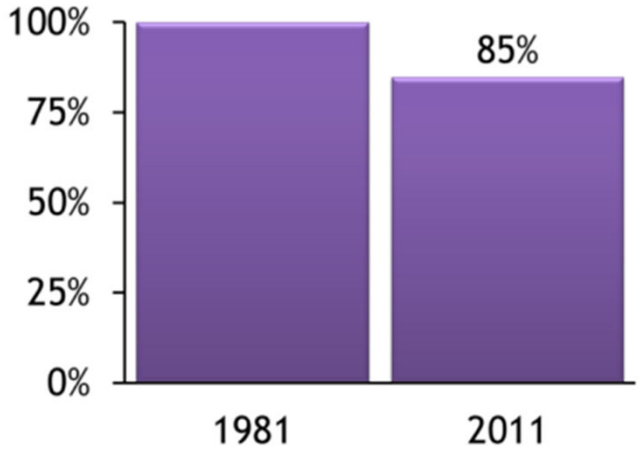
- In North America, the livestock industry is making progress to reduce greenhouse gas (GHG) and ammonia emissions, as well as water and land use (Rotz et al., 2019, Legesse et al., 2016, 2018).

Footprint of Canadian Beef

Beef produced in Canada in 2011 required **24% less land than 1981**



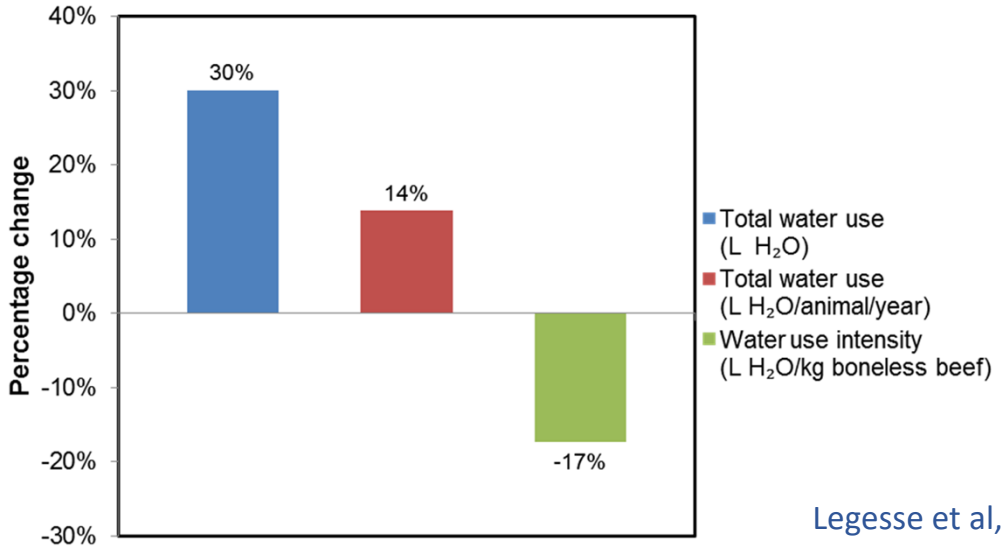
Beef produced in Canada in 2011 had a **15% smaller carbon footprint than 1981**



Legesse et al, 2016a

Footprint of Canadian Beef

Percentage change in **water use** in Canadian beef industry from 1981 to 2011



Legesse et al, 2018

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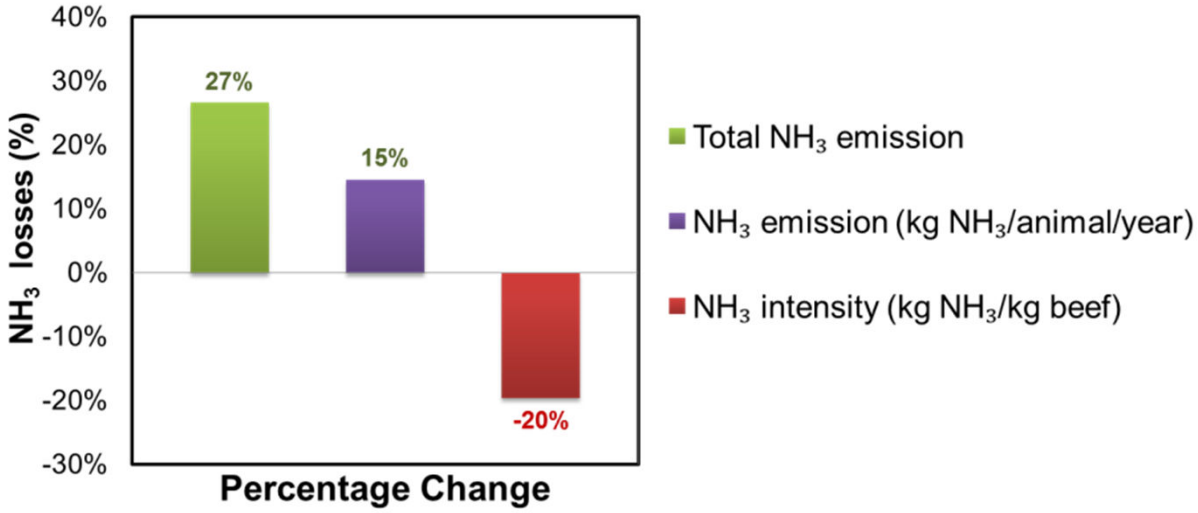
Footprint of Canadian Beef



Legesse et al, 2016b

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Food Loss and Waste: A Global Priority

- United Nations (UN) 2030 goal to:

"…halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" (UN, 2015)

UNITED NATIONS

Food loss and waste:

A sustainable source of feed for livestock?

Improve resource use efficiency while reducing the environmental footprint?

The difference between

FOOD LOSS & FOOD WASTE

takes place at

Production
Postharvest
Processing stages
Distribution

happens at

Retail
Consumption

Food and Agriculture Organization of the United Nations

#ZeroHunger

Food Loss and Waste: A Global Issue

- Globally:
  - All edible food – 1/3 (FAO, 2011)
  - Food Loss Index - 14% lost before retail (FAO, 2019)
  - Food Waste Index – under review

- US- 62.5 million tons (ReFed 2016, Dou et al., 2018)
  - Production/unharvested crops – 10.1 million tons
  - Retail/Consumer – 52.4 million tons


FOOD WASTE IN CANADA
THE FACTS
58%
of food produced in Canada is lost or wasted each year.
35.5 MILLION TONNES
of food produced in Canada is lost or wasted each year.
32 %
of this, amounting to
11.2 MILLION TONNES
could be rescued to support communities across Canada.
This is equivalent to the weight of almost
95
CN TOWERS
Food waste costs Canada's economy more than
$49 BILLION
each year.
Each year, food waste in Canada creates about
56.6 MILLION TONNES
of carbon dioxide-equivalent emissions.
Organics wasted in a landfill produce methane gas which is
25 TIMES
more damaging to the environment than carbon dioxide.
The average Canadian household spends
$1,766
on food that is wasted every year.
Source:
The Avoidable Crisis of Food Waste (2019): Roadmap; Second Harvest and Value Chain Management International
#WasteReductionWeek
WASTE REDUCTION WEEK IN CANADA
WRWCanada.com

Hierarchy of Recovery

Source:
www.waste4change.com

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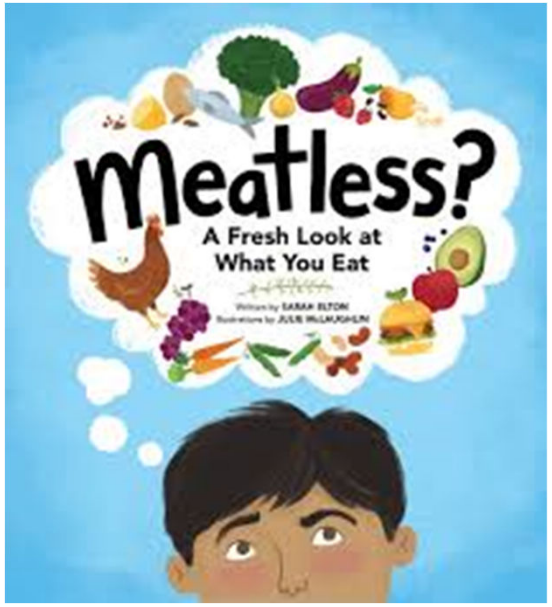
Searching for the Sustainable Diet



Hierarchy of Recovery

Source:
www.waste4change.com

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Current Utilization of Food Loss in the Livestock Sector

- Source:
  - Grains, pulses and oilseeds that fail to reach quality grade required for human consumption
    Example: sprouted malt barley

  - Screenings

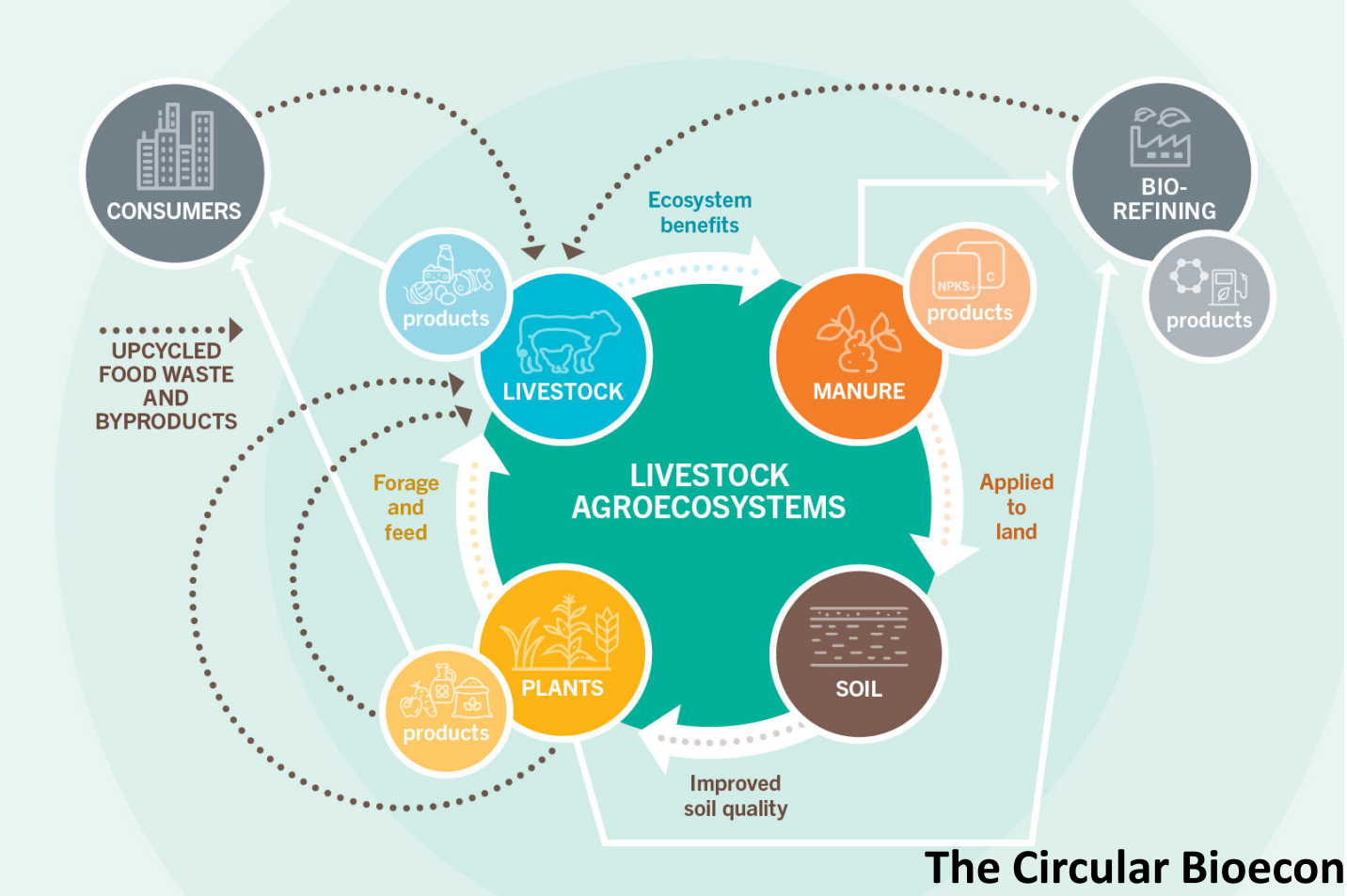
Current Utilization of Food Loss in the Livestock Sector

- By-products
  - Oilseeds (canola, flax, sunflower)
  - Milling industry (wheat bran, oat hulls)
  - Vegetable industry (potato peels, culls)
  - Breweries and distilleries (DDGS)
  - Product processing (whey)
  - Novel plant-based protein sources (peas, quinoa, camolina)

By-products or Co-products?

- By-products are now being re-framed as “co-products”
  - Example: Roquette – world’s largest pea plant located in MB
    - Biopharma, pharma & nutraceuticals, cosmetics, food and nutrition, **animal nutrition**
      - Pea screenings
      - Pea hulls
      - Pea cream

Role of Livestock in Sustainable Food Systems



The Circular Bioeconomy

Food Waste from Distributors, Retailers and Households: Expanding the Circularity?

Puente-Rodriguez et al., 2022

Opportunities to Include Food Loss and Waste in Livestock Diets

- Japan:
  - 40% of food waste recycled for animal feeding
- South Korea:
  - 45% of food waste recovered as animal feed
  - Treated wet or dried to facilitate long distance transportation

KO [2]1

Nutrient Profile of Food Waste

	DM%	CP%	EE%	NFE%	CF%
# of samples	20	23	21	8	15
Minimum	19.1	12.9	7.0	32.3	0.8
Maximum	97.9	31.1	27.2	81.7	15.3
Mean	78.3	19.3	13.5	53.7	7.3

Rajeh et al., 2020

Slide 21

KO [2]1 check source of food waste - bread, veg, fruit etc and in what country
Kim Ominski, 2022-06-24

Animal Performance

Food waste type	Inclusion level	Livestock species	Outcome	Reference/ country
Dried household food waste	75%	Steers	No significant effect on slaughter weight, dressing parentage, retail cut	Paek et al. (2005)/Korea
Potato processing waste	up to 80%	Steers	Potato processing waste can substitute barley in finishing diets without any negative implications on growth performance or meat quality	Duynisveld and Charmley (2016)/Canada
Restaurant food waste (77%)-broiler litter (10%)-bakery waste (13%) mixture	Up to 50%	Pigs	Similar feeding value as corn-soy control diet. Inclusion increased FCR and did not affect final BW, ADG	Kwak and Kang (2006)/Korea
Dehydrated food waste	Up to 20%	Chickens	Increased FCR and food waste did not affect meat quality and sensory scores	Chen et al. (2007)/Taiwan

Dou et al, 2018

Feed Conversion Ratios:

- kg feed : kg gain
- kg feed : kg beef protein
- kg human edible feed : kg beef protein
- kg protein : kg beef protein
- kg human edible protein : kg beef protein

Environmental Impact

- Life cycle assessments (**LCAs**) are now being conducted to determine the environmental implications of traditional disposal streams for food loss and waste (anaerobic digestion, landfill, and composting) compared with their use as livestock feed.

- “Up-stream” impacts along the food chain, including energy, fertilizer, water, and land use as well as greenhouse gas (**GHG**) and ammonia emissions are necessary

Partial LCA – Use of Potatoes in Feedlot Diets

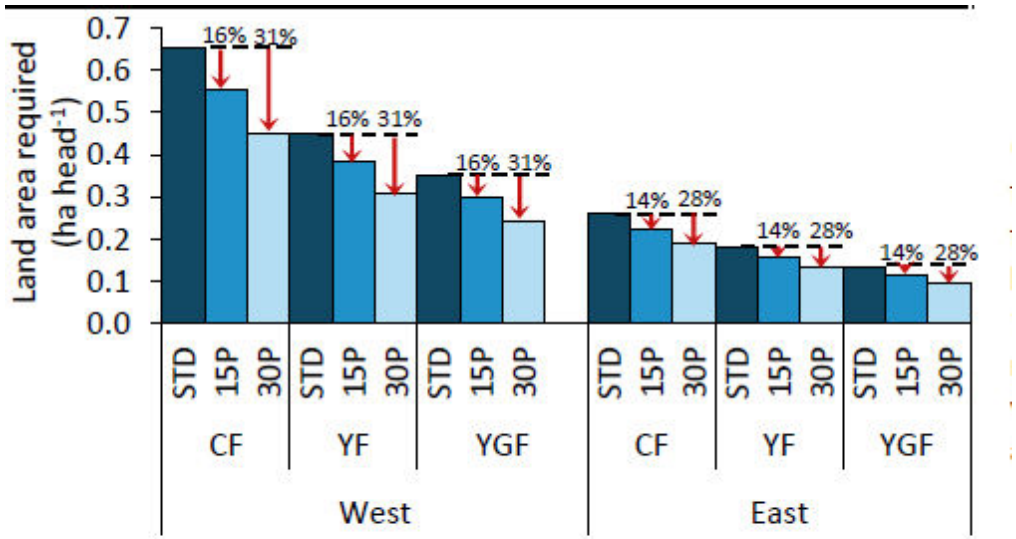


Figure 1. Land area required to grow feedstuffs included in feedlot diets containing grains (STD) or potato waste at 15% (15P) and 30% (30P) of diet DM in western and eastern Canada.

Mengistu et al., 2022

Including potato waste in feedlot cattle diets:

- Reduced GHG emissions
- Reduced land required
- Reduced landfill emissions and disposal costs.

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SK3

Environmental Impact

- A LCA (Salemdeeb et al., 2017) used 14 environmental and health indicators and demonstrated that converting municipal waste to feed for pig production lowered the environmental impact compared with:
  - anaerobic digestion
  - composting
  - with wet-processing superior to dry processing for all environmental indicators

Slide 26

SK3 Would suggest deleting this slide
Stanford, Kim, 2022-06-24

Public trust?

IPSOS survey to establish consumer perceptions regarding use of food loss/waste in livestock diets

https://vimeo.com/601193121/70f2d91401

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Public Trust

THE WESTERN PRODUCER

Feedlot food waste management finds positive reaction

By Melissa Bezan

Reading Time: 2 minutes

Published: September 30, 2021

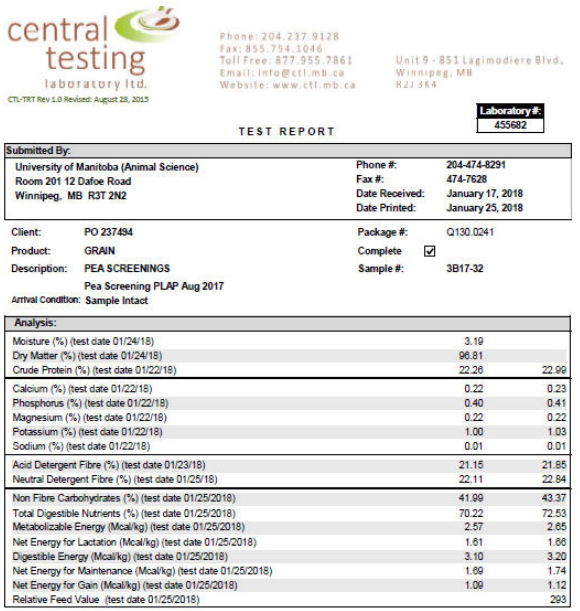
Livestock

"Because we are so far removed from it, I think us city folk aren't aware of what farmers are doing. It's genius what some of them have come up with such as using grain mash or products that are unfit for people for their herds. It diverts unnecessary waste and turns it into a valuable commodity and diversifies the animals' diet."

Challenges

Assessing Nutrient Quality

- Nutrient composition may vary considerably within and between loads
- Rapid and accurate assessment to determine nutritional value if these products are to be used by nutritionists in precision feeding programs
- *On-farm use of near-infrared spectroscopy (**NIRS**) for rapid assessment of feed value, and the detection of mycotoxins and contaminants in food waste?*



central testing laboratory ltd.

Phone: 204.237.9128
Fax: 855.734.1046
Toll Free: 877.955.7861
Email: info@ctl.mb.ca
Website: www.ctl.mb.ca

Unit 9 - 851 Lagimodiere Blvd.
Winnipeg, MB
R2J 5K4

CTL-TRT Rev 1.0 Revised: August 28, 2015

TEST REPORT

Laboratory #: 455682

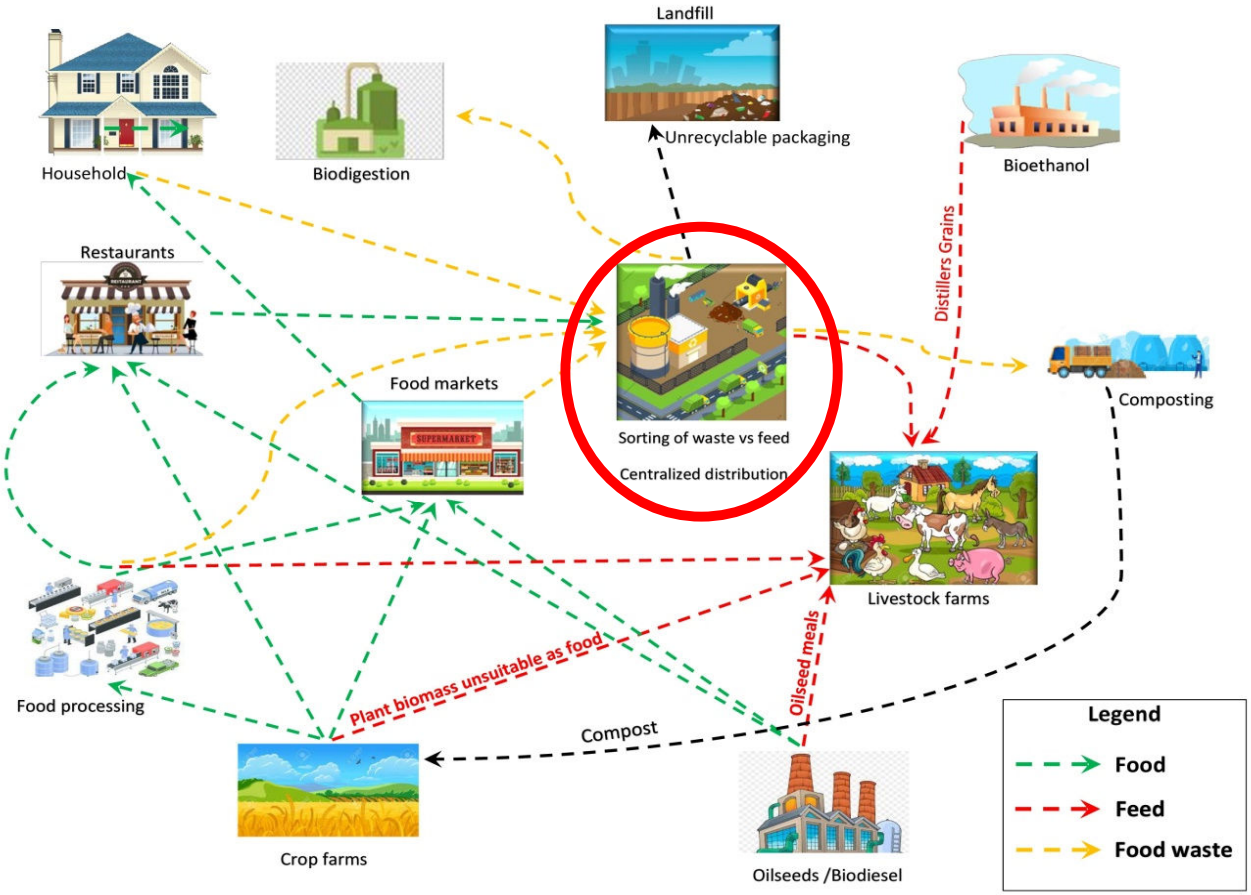
Submitted By:			
University of Manitoba (Animal Science) Room 201 12 Dafoe Road Winnipeg, MB R3T 2N2		Phone #: Fax #: Date Received: Date Printed:	204-474-8291 474-7628 January 17, 2018 January 25, 2018
Client:	PO 237494	Package #:	Q130.0241
Product:	GRAIN	Complete	☑
Description:	PEA SCREENINGS Pea Screening PLAP Aug 2017	Sample #:	3B17-32
Arrival Condition:	Sample Intact		

Analysis:		
Moisture (%) (test date 01/24/18)	3.19	
Dry Matter (%) (test date 01/24/18)	96.81	
Crude Protein (%) (test date 01/22/18)	22.26	22.99
Calcium (%) (test date 01/22/18)	0.22	0.23
Phosphorus (%) (test date 01/22/18)	0.40	0.41
Magnesium (%) (test date 01/22/18)	0.22	0.22
Potassium (%) (test date 01/22/18)	1.00	1.03
Sodium (%) (test date 01/22/18)	0.01	0.01
Acid Detergent Fibre (%) (test date 01/23/18)	21.15	21.85
Neutral Detergent Fibre (%) (test date 01/25/18)	22.11	22.84
Non Fibre Carbohydrates (%) (test date 01/25/2018)	41.99	43.37
Total Digestible Nutrients (%) (test date 01/25/2018)	70.22	72.53
Metabolizable Energy (Mcal/kg) (test date 01/25/2018)	2.57	2.65
Net Energy for Lactation (Mcal/kg) (test date 01/25/2018)	1.61	1.66
Digestible Energy (Mcal/kg) (test date 01/25/2018)	3.10	3.20
Net Energy for Maintenance (Mcal/kg) (test date 01/25/2018)	1.69	1.74
Net Energy for Gain (Mcal/kg) (test date 01/25/2018)	1.09	1.12
Relative Feed Value (test date 01/25/2018)		293

Collection and Distribution Logistics

- Food loss and waste is produced near large urban centers.
- Transportation of food waste over long distances creates logistical and cost challenges and therefore is often diverted to landfills, composted, or used in biogas production

Collection and Distribution Logistics



- *Centralized processing, testing and distribution centers? Trade offs?*

Regulatory Restrictions

- In Canada, inclusion of food waste in livestock diets is regulated by the Canadian Food Inspection Agency
- Existing regulations prevent or restrict use (i.e., Enhanced Feed Ban)
- Some novel by-products associated with new processing technologies and changes in consumer demand are not currently included (i.e. hemp)
- Research needed to support policy changes to facilitate safe expansion of the use of food loss and waste in livestock diets

Feed Safety

- Potential contaminants can be found in by-products and food waste (CFIA, 2019).
  - Mycotoxins, herbicides, fungicides, pesticide residues, pathogens, antinutritional factors (glycoalkaloids, tannins), heavy metals, glass, metal, and plastic packaging
- The high-moisture content of many fruit and vegetable by-products and food waste creates an ideal environment for the growth of bacteria/fungi/parasites that may produce toxins
- Economic viability and effectiveness of preservation techniques?

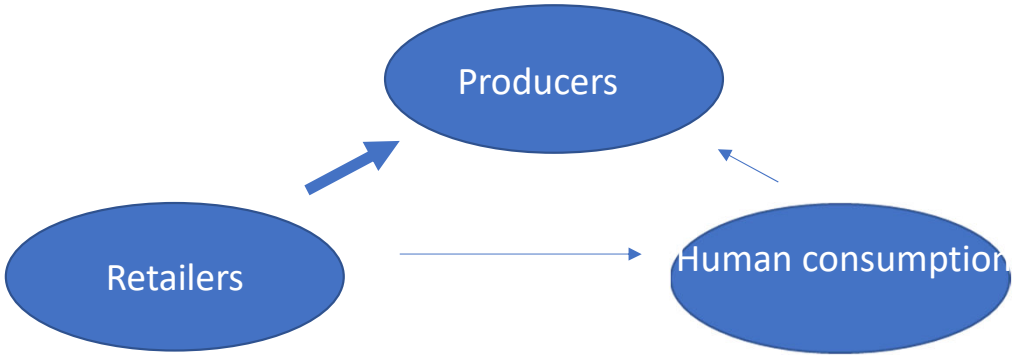
Feed Safety

- Techniques to preserve food waste:
  - heat sterilization
  - heat sterilization plus drying to 80% - 95% DM
  - ensiling alone or after heat treatment with or without addition of fermentation aids (bacteria, enzymes, or acids)
  - enzymatic treatment

(Dou et al. 2018)

Loop Resources: Connecting producers and retailers

"Taking food after charities and shelters have been given access and diverting to livestock" –
Jaime White founder of Loop Resources
https://loopresource.ca



Loop

Use of Surplus Food from Retailers

Role of Loop:

- Train producers (10 producers/store) – regulatory restrictions and logistics
- Train retail staff
- Contract administration/logistics support

Use of Surplus Food from Retailers

Benefits:

- **Retailers are incentivized**
  - Cost is less than moving surplus food to landfill
  - Guaranteed pick up by producers
  - Corporate image - Improving food/feed security

- **Producers:**
  - Pay transportation costs only
  - Alternative feed source – drought, flooding

Loop Resources

Current status:

- Approximately **3 million kg of surplus food diverted monthly (over 30 million kg annually)** from retailers to **2500-3500 producers** from coast-to-coast in Canada
- Approximately **300 kg of waste/store/day is redirected**
- On average, retail waste produced = square footage/100 – except for retailers located at each end of the continuum
- Primarily diverted to small/medium-sized farms (up to 100 cows)
- Supply of food waste and demand from producers varies by region

Loop Resources

Future Opportunities

- Covid has led to on-line training of retailers and producers – expanded capacity
- Next step is to grow partnerships with co-packing facilities (distribution centers):
  - Consistent supply of surplus food to larger livestock operations
- Can triple in size with current model

Conclusions

- Redirection of food waste from landfills is necessary to improve global food and feed security
- Cattle with their capacity to “up-cycle” relatively low-quality feedstuffs into high-quality protein are an essential element in addressing the food waste challenge
- Canadian producers are recognized globally:
  - Animal care standards, milk, meat and egg quality and efficiency of production.
  - Demonstrated interest, ingenuity, and investment to replace traditional feeds with by-products and even food waste but there are gaps

Conclusions

Fills gaps to empower regulatory and public policy change:

- Better characterize quality and availability
- Preservation and feeding strategies to ensure animal performance
- Cost of production analysis
- Environmental assessments (GHG and ammonia emissions as well as land and water use)

Conclusions

- A range of solutions:
  - Incentives may be necessary for producers and processors to recover more food
  - Disincentives to waste food will be influenced by food prices and costs for food disposal
- A coordinated approach requiring input from producers, feed suppliers, researchers, policy makers, and retailers is critical for the development of successful strategies for inclusion of food loss and waste in livestock diets

SAVE THE DATE

SUSTAINABILITY OF CANADIAN AGRICULTURE

2023 VIRTUAL CONFERENCE

MARCH 7- 9, 2023

Tuesday March 7
Achieving net zero emissions

Wednesday March 8
Role of Indigenous agriculture in our food systems
HOLOS model workshop

Thursday March 9
Is biodiversity the new carbon?
Canada's Living Lab Update

Registration is opening soon!
Come and visit us at:
https://umanitoba.ca/agricultural-food-sciences/sustainability-canadian-agriculture-2023

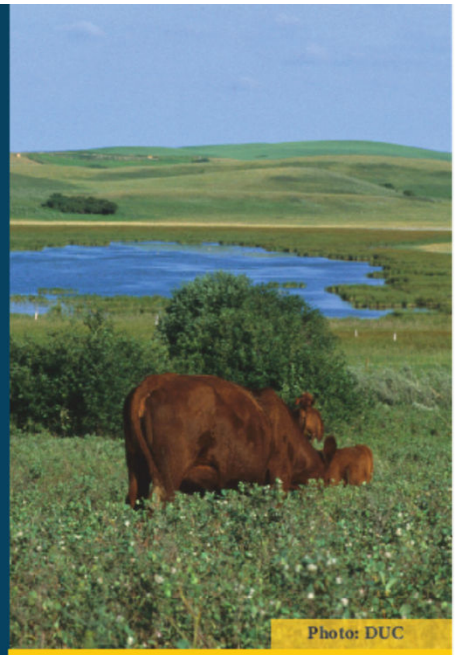


Photo: DUC

Sustainable food production systems: Exploring new and traditional knowledge

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ncle National Centre for Livestock and the Environment
umanitoba.ca/afs/ncle

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Holos


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Extra slides

Nutrient Profile of Food Waste

Food waste source	DM%	CP%	EE%	NFE%	Fiber%	Reference
Restaurant	22.4	21.4	27.2	-	-	Westendorf et al. (1998)
Restaurant	39.6	27.5	28.8	26.9	2.3	Garcia et al. (2005)
Household	33.1	16.3	11.3	41.8	12.4	
Household	85.3	20.1	9.1	-	-	Paek et al. (2005)
Restaurant	22.8	28.6	31.5	-	3.1	Jin et al. (2012)

Dou et al., 2018

Are livestock a sustainable solution to the food loss and waste challenge?

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