EXTENDED BALE GRAZING AS A GREENHOUSE GAS MITIGATING ALTERNATIVE TO TRADITIONAL DRY LOT OVERWINTERING IN WESTERN CANADA BEEF PRODUCTION: A LIFE CYCLE EVALUATION

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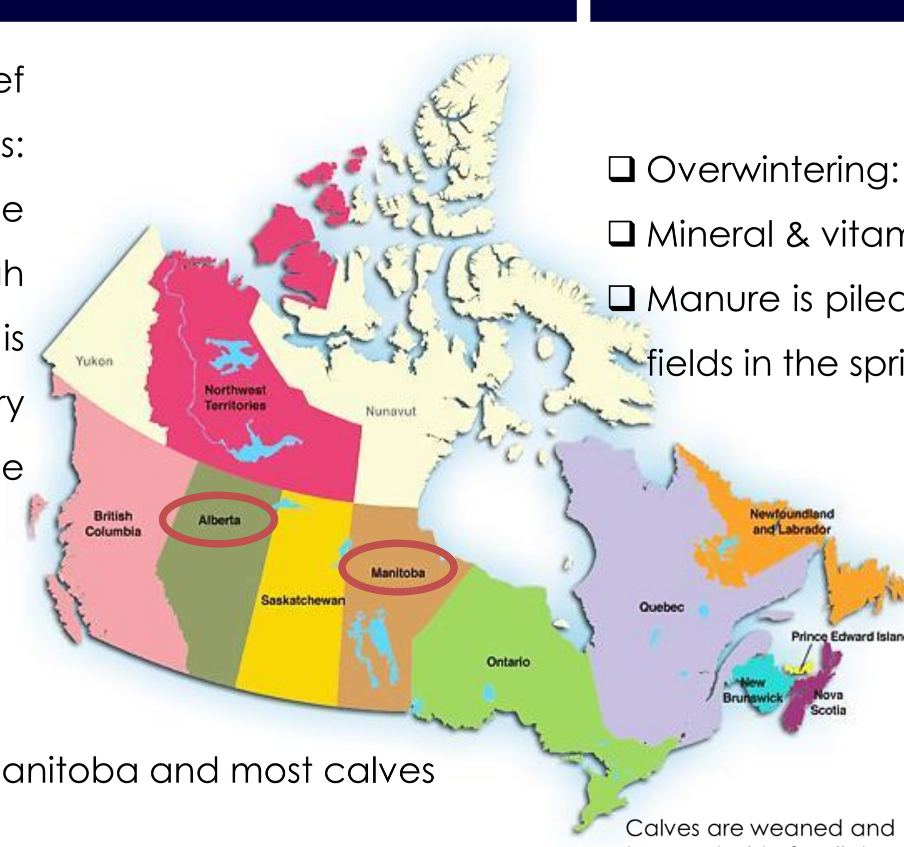
INTRODUCTION, GOAL & SCOPE

Canada is a leading beef-producing and exporting country. Beef production systems in western Canada are operated in two major phases: a cow-calf phase and a finishing phase. Manitoba is trying to reduce greenhouse gas (GHG) emissions from cow-calf operations through Beneficial Management Practices (**BMP**). Extended bale grazing (**EBG**) is increasingly used as a cost-effective overwintering strategy along with dry lot overwintering (**DLO**) operations, and was analyzed to determine whether it could be used as a BMP for GHG emission reduction.



GOAL: Compare GHG impacts of producing a market-ready beef animal using DLO vs. EBG overwintering strategies

SYSTEM BOUNDARY: Cradle-to-farm gate. Cow-calf operations occur in Manitoba and most calves are sent for finishing to Alberta.

FUNCTIONAL UNIT: 1 kg live weight market-ready beef animal (605 kg) based on producing and finishing a weaned calf (250 kg) over 494 days

METHODS & TOOLS: SimaPro, Holos (IPCC equations and parameters), CowBytes (feed rations)

PRODUCTION SYSTEMS

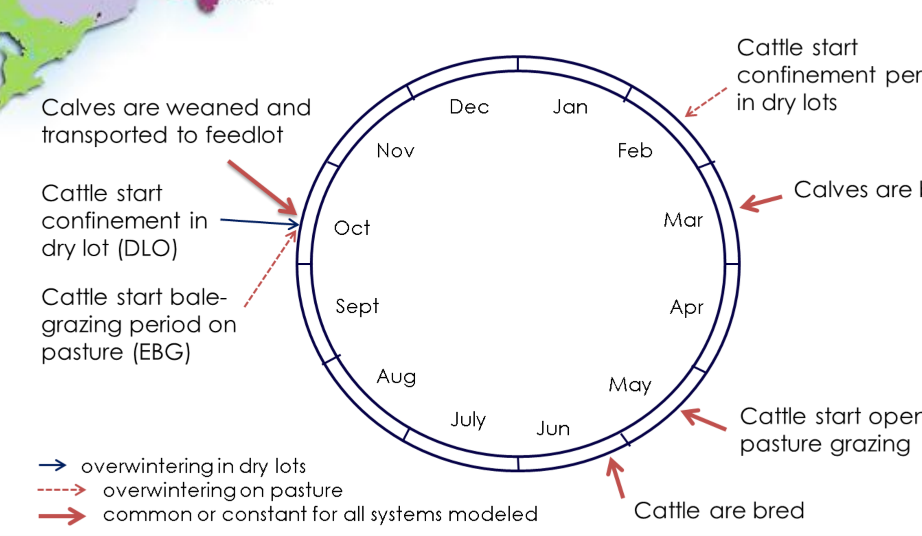
COW-CALF OPERATIONS (Manitoba)

DLO (31% of farms)

- ❑ Overwintering: 7 months in confinement on dry lots
- ❑ Mineral & vitamin supplements are left at dry lot
- ❑ Manure is piled, then collected and spread on hay fields in the spring

EBG (21% of farms)

- ❑ Overwintering: 4 months on pasture & 3 months in confinement
- ❑ Mineral & vitamin supplements left on pasture
- ❑ Ration for pregnant cows was adjusted based on the environment temperature & wind speed
- ❑ Reduced manure management as no manure handling during bale grazing



FEEDLOT OPERATIONS (Alberta)

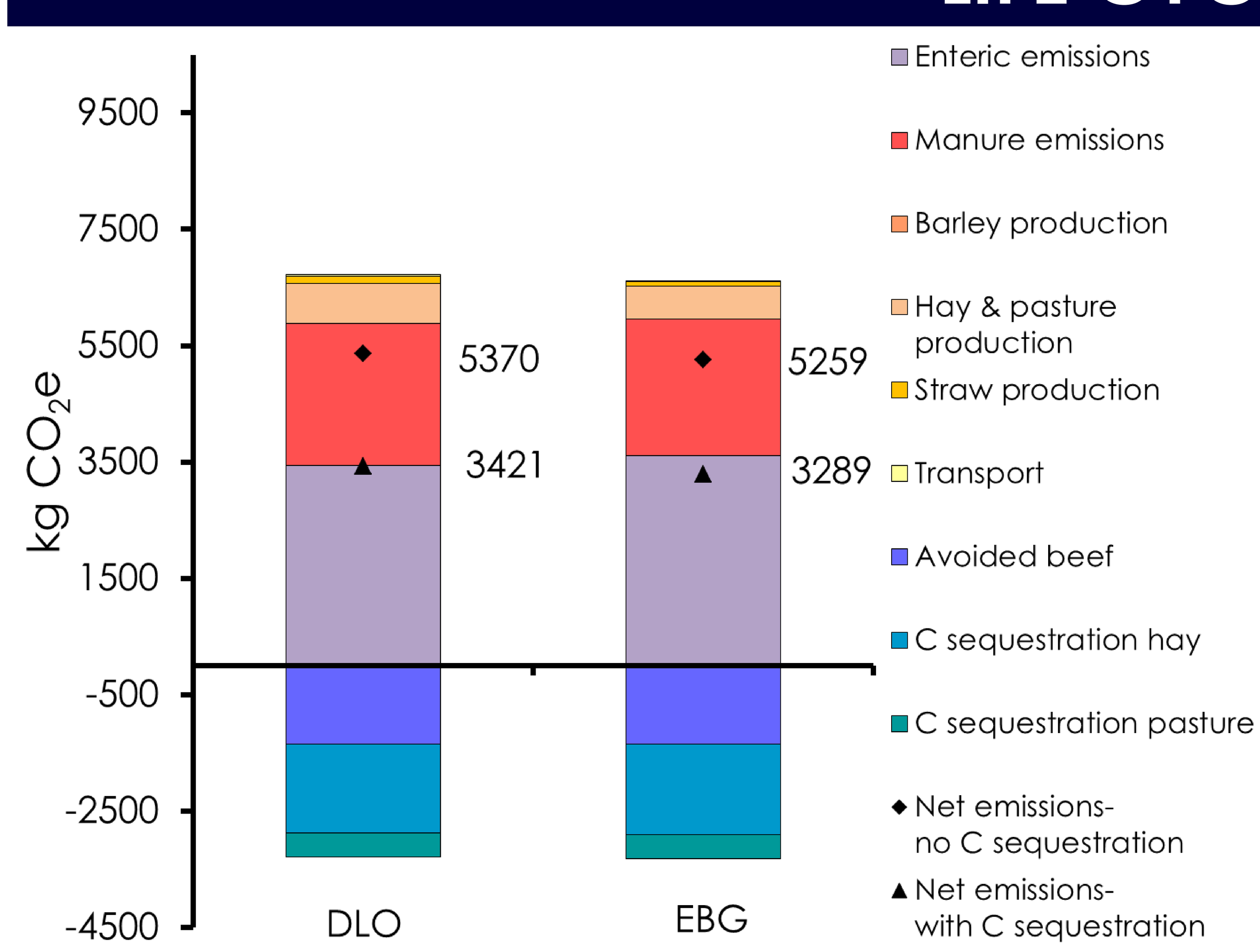
Backgrounding (110 days)

60% barley silage & 40% barley grain (360kg)

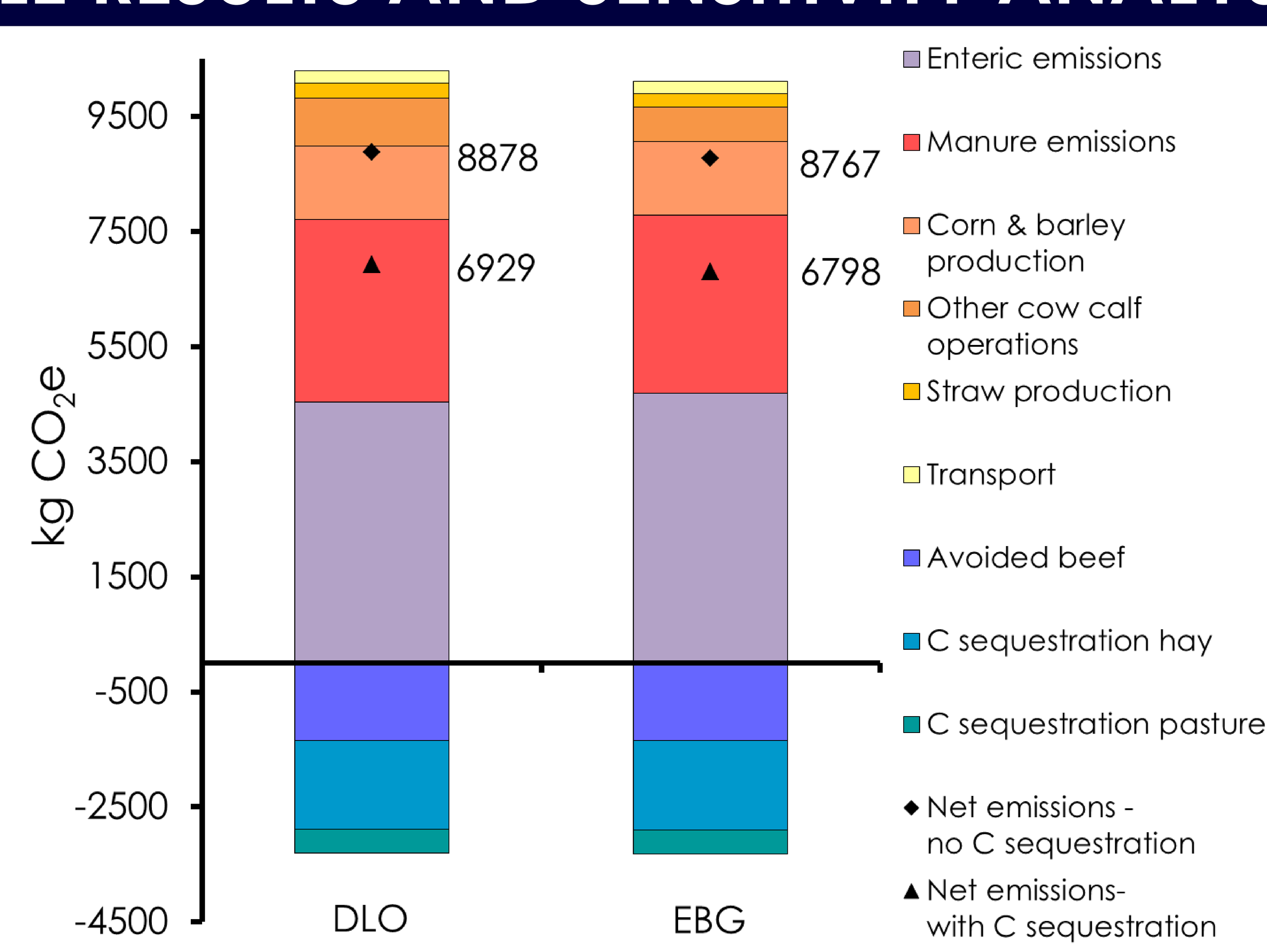
Finishing (170 days)

10% barley silage & 90% barley grain (605kg)

LIFE CYCLE RESULTS AND SENSITIVITY ANALYSIS



Net GHG emissions per 7 month old weaned calf (250 kg) Including soil C sequestration sensitivity analysis



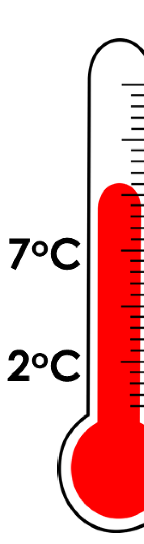
Net GHG emissions per 16 month old finished animal (605 kg) Including soil C sequestration sensitivity analysis

- ❑ Enteric and manure emissions are biggest contributors to GHGs
- ❑ EBG reduces GHG emissions by 2.1% relative to DLO for cow-calf operations & 1.3% on a cradle-to-farm gate basis (excluding C sequestration)
- ❑ Although enteric emissions increased in EBG due to colder temperatures, manure emissions decreased due to differences in manure management
- ❑ DLO =11.5 & 14.7 kg CO_2e/kg live weight of beef with & without carbon sequestration, respectively
- ❑ EBG =11.2 & 14.5 kg CO_2e/kg live weight of beef with & without carbon sequestration, respectively

❑ Life cycle GHG emissions are within the range reported by other studies

EXISTING STUDIES	kg CO_2e/ kg live weight	REGION	SCOPE
Beauchemin et al. (2011)	13.0	Western Canada	Not including C sequestration
Vergé et al. (2008)	10.1	Western Canada	Not including C sequestration
Pelletier et al. (2010)	14.8	US Mid-West	Similar boundaries & assumptions
Lupo et al. (2013)	12.7	US Northern Great Plains	Similar boundaries & assumptions

TEMPERATURE DIFFERENCE SENSITIVITY ANALYSIS



	Cow-calf operations (kg CO_2-eq / 250 kg weaned calf)		Full life cycle (kg CO_2-eq / 605 kg finished animal)	
7°C	5177	5191	8685	8699
	DLO – EBG = 14			
2°C	5259	5370	8767	8878
	DLO – EBG = 111			
	EBG	DLO	EBG	DLO

- ❑ Ambient temperatures affect feed consumption and enteric & manure GHG emissions
- ❑ Compared to pasture lands, dry lots were assumed to be 2°C warmer (October-February) due to lower exposure to winds & presence of bedding in dry lots
- ❑ Actual temperatures that animals in dry lots are exposed to are unknown
- ❑ Sensitivity analysis was conducted to determine how total GHG emissions change when assumed temperature difference between dry lots and pasture lands is increased by up to 7°C
- ❑ Despite decreased GHG emissions for both overwintering strategies, overall emissions associated with EBG remain lower compared to DLO operations
- ❑ The larger the temperature difference, the smaller the difference in GHG emissions between two strategies
- ❑ With temperature difference more than 9°C, overall GHG emissions of DLO could be smaller than EBG

KEY FINDINGS & RECOMMENDATIONS

BENEFICIAL MANAGEMENT PRACTICES

- ❑ Although cost-effective, EBG results in relatively small GHG emission reduction, particularly when uncertainties in data and IPCC emission factors are considered
- ❑ EBG has a higher potential for nutrient runoff relative to DLO, thus it is important to routinely change area that cattle bale graze on to prevent over fertilization and nutrient runoff in fields that are in close proximity to water bodies

LIMITATIONS

- ❑ Uncertainties in C sequestration rates & IPCC emission factors related to nitrous oxide dynamics
- ❑ Limited data on feed impacts on enteric emissions
- ❑ Inadequate impact assessment methods to analyze environmental trade-offs due to differences in P/ N dynamics between the 2 systems

FURTHER RESEARCH

- ❑ Include other impacts (e.g. eutrophication of Lake Winnipeg in Manitoba is a concern)
- ❑ Uncertainty associated with C sequestration rates and the potential for pasture and perennial hay systems to sequester carbon – crucial for understanding the impact of GHG emissions from beef production systems

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4