Estimating the Marginal Cost of Methane Abatement for Representative Feedlot Operations in Canada

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INTRODUCTION

The Need to Reduce Methane Emissions:

- Canada's 'net zero' emissions target by 2050.
- 71% of Canada's total agricultural methane emissions comes from beef production (Government of Canada, 2022).
- Alberta's feedlot sector is responsible for a significant share of the province's agricultural methane emissions, representing high-density, localized methane 'hotspots' (McGinn et al., 2008).
- The agricultural sector is the largest source of unregulated and unpriced GHG emissions in the country (Cooper et al., 2013).
- Reducing methane emissions is not only crucial for the environment, but can also improve efficiency in beef production, reducing the loss of feed energy (ABP, 2016).

OBJECTIVES

First Objective:

Identify effective methane abatement strategies:

- Review literature on methane reduction in feedlot cattle operations.
- Ensure strategies don't impair cattle productivity.

Second Objective:

Explore and evaluate the cost-effectiveness of these strategies:

- Find the cost of implementation and analyze economic viability.
- Construct marginal abatement cost curves to inform policy.

METHODS AND MARGINAL ABATEMENT COST CURVE DEVELOPMENT

Selection of Measures:

- Measures that reduce absolute emissions without negatively impacting beef production
- Measures that increase beef production without increasing emissions.
- Gathered reported percent reductions in enteric mitigation strategies, along with their cost of implementation from existing literature.

Bottom-up Engineering Approach:

- Constructed MACCs using regional activity data, not direct emissions measurement.
- Focused on technical potential of each mitigation measure.
- Evaluated effectiveness incrementally by comparing current practice (status quo) plus specific mitigation measures.
- MACC created as a set of discrete bars ranking mitigation measures based on increasing cost per unit of emissions abated.

TECHNICAL FEASIBILITY OF MITIGATION OPTIONS IN ALBERTA

Strategy	CH4 Reduction Potential (g/d)	Expected Availability	Feasibility of Implementation
Breeding for Low RFI	Low to Medium (15-28%)	Immediate	Industry wide collaboration. Protocols needed to verify genetic efficiency of incoming cattle. Cost-effective.
Feed Management	Low -Medium (15-23%)	Immediate	Feasible, but highly dependent upon weather and environmental factors.
Ionophores	Low (5-15%)	Immediate	Confined beef production.
Lipid Supplementation	Medium to High (17-33%)	Immediate	Feasible for cattle fed diets. Can be expensive.
3-NOP	High (45-85%)	Immediate, approved in Canada as of 2023	Highly applicable for beef feedlots. Difficult for grazing. Financial incentives required.
Red Seaweed	High (60-90%)	Available, but not widespread	Highly applicable for beef feedlots. Needs global scale production and Regulatory acceptance. Financial incentives required.

MAIN CONCLUSIONS

Leading Strategies::

3-nitrooxypopanol (3-NOP) and Red Seaweed

- Significant methane reduction potential but prohibitively expensive in both MACC scenarios.
- Major Economic trade-off for producers.

Cost-Effective Solutions:

Low Residual Feed Intake (RFI) Breeding, Feed Management, and Ionophores.

- Cost-effective with the potential of financial gains, aligning with both economic and environmental goals.

POLICY IMPLICATIONS

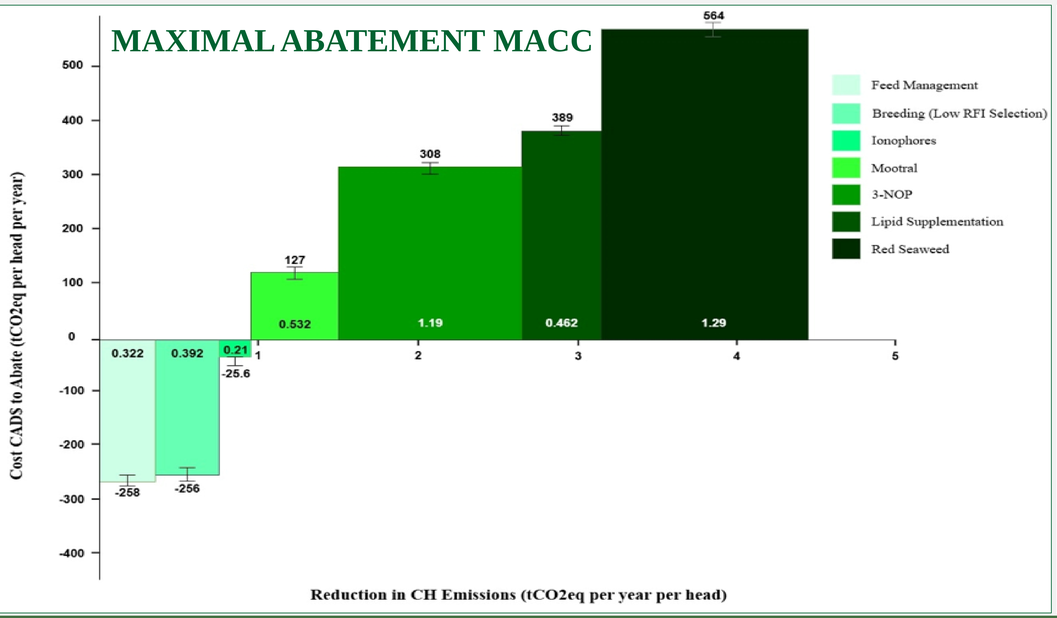
Incentives for Scalability and Economies of Scale:

- Governments can support innovation and scalability (e.g. scaling up production of feed additives like 3-NOP and red seaweed).
- Hybrid Market Based Approach: Tax and subsidy policies that recycle emissions tax revenue back to the producer to subsidize adoption of more expensive technologies with higher abatement potential.
- MACCs can guide the pricing of offsets (e.g. establishing the price for carbon credits) aligning the financial incentives with the actual cost for reducing emissions.

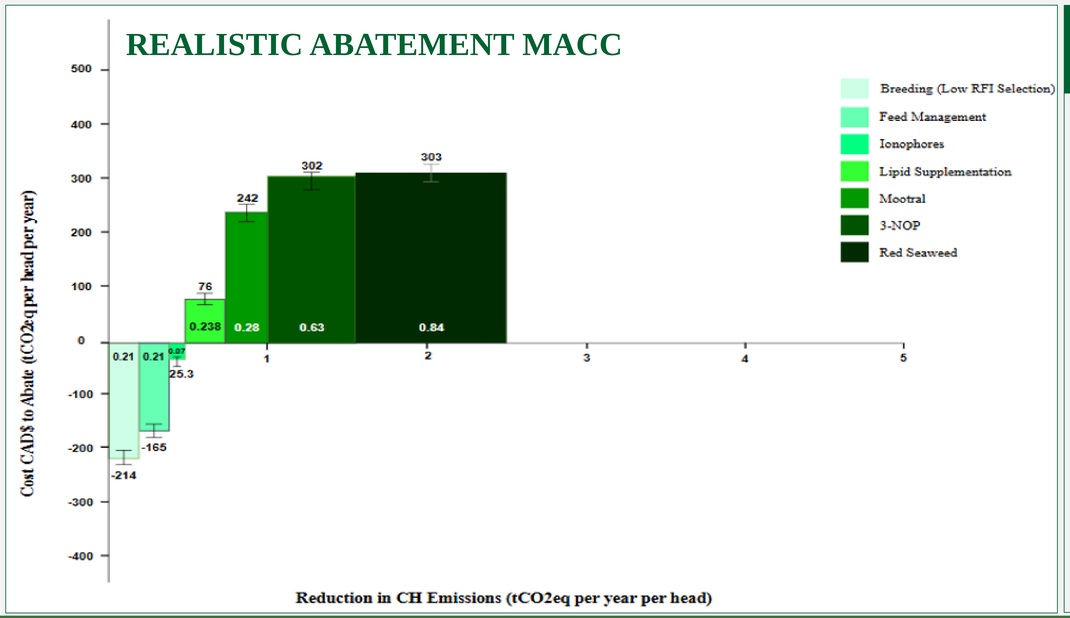
Collaborative Engagement:

The key to success will lie in the collaborative engagement of all stakeholders, alongside continued innovation and research to improve the cost-effectiveness of these mitigation strategies.

MAXIMAL ABATEMENT MACC



REALISTIC ABATEMENT MACC



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