DALHOUSIE UNIVERSITY
Inspiring Minds
Faculty of Agriculture

Modeling greenhouse gas (GHG) emissions in dairy farms under different water management systems: A case in Nova Scotia, Canada

At the Dalhousie University, Faculty of Agriculture in Bible Hill, Nova Scotia, research was conducted to evaluate a sub-irrigation system for use on pasture farms that hypothetically creates a net neutral greenhouse gas livestock production. The system involves a network of underground pipes and chambers that collect and distribute water to the dairy pasture as necessary. In times of heavy rainfall, the system ensures that the pasture is receiving the optimal amount of moisture, as well as store water for times of drought. Research has suggested that implementing this system has increased soil moisture quality, reduced environmental impact, and aided in reducing greenhouse gas emissions.

Research Objectives

- To investigate the effects of different water management systems on GHG emissions in dairy farming
- To identify the changes in milk attributes operated under different water management systems
- To gauge dairy farmers' attitudes towards adopting sub-irrigation system and determine which factors caused for their attitude
- To identify the significant sources for GHG emissions

Key Findings

Willingness of Farmers to Adopt Irrigation Systems in Livestock Pastures

- Half of respondents would be willing to adopt the sub-surface irrigation system if the government paid at least half the costs
- Nearly 90% would if the government covered the cost

Use HOLOS modeling software to estimate GHG emissions

- According to the HOLOS modelling, by pasturing the dairy cows during the summer months, Enteric CH4 increases by 1 Mg

Regression modelling of Phase 1 data with climate data

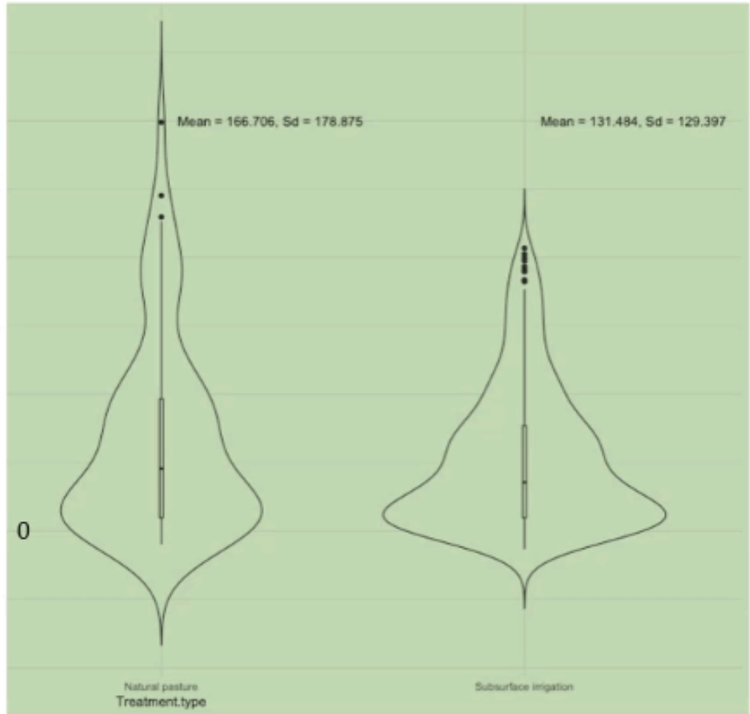
- Sub-surface irrigation lowered the Co2 emissions by 4.762 tonnes per hectare when compared to the natural pasture (24% reduction)

Milk production and quality based on field treatment

- Cows being on the irrigated pasture did not improve milk value compare to the natural and drained pasture types

Regression Model

$$Gas\ flux = \beta_0 + \beta_1 Sub - surface\ irrigation + \beta_2 Conventional\ tile\ drainage + \beta_3 Soil\ moisture\ content + \beta_4 Temperature + \beta_5 Soil\ temperature + \beta_6 Precipitation)$$



Recommended Follow-up Study

- Compare 3 types of fields for emissions (natural, drained, plus drained and irrigated)
- Measure gas fluxes with the newer sensors used at McGill
- Measure (or look for a way to measure) gas fluxes from runoff ditches and the holding pond (likely through water testing)
- Include more animals in weekly milk tests (rotating them through the three types of pasture)
- Measure feed intake and feed type (when the animals are not on the pasture)
- Investigate other models (in addition to HOLOS)