

CHARACTERIZE CALIFORNIA-SPECIFIC CATTLE FEED RATIONS AND IMPROVE MODELING OF ENTERIC FERMENTATION FOR CALIFORNIA'S GHG INVENTORY

I. OBJECTIVE

The purpose of this study is to improve the modeling methodology for estimating cattle enteric fermentation emissions in the California Greenhouse Gas (GHG) Emission Inventory by collecting and modeling California-specific feed data. The modeled results from this study will be compared to the national default model currently used in the California inventory, as well as other models. This study will inform how the diets of California cattle are different from the rest of the nation, and how it affects methane emissions. An improved emissions estimate for the GHG Emission Inventory based on California-specific data will better reflect on-farm realities and better inform policy decisions for focusing sectoral GHG goals, improve understanding of regional emissions, and inform the development of short-lived climate pollutant reduction strategies.

II. BACKGROUND

California cattle operations, primarily dairies, are a significant source of GHGs. Enteric fermentation (bacterial decomposition of feed in ruminant stomachs) emits GHGs, most notably methane in eructation (burping). Enteric fermentation from cattle contributes nearly 30 percent of the statewide methane emission inventory, currently the largest inventoried source of methane statewide. Ninety five percent of California's enteric methane emissions come from cattle, approximately 3/4 of which are from dairy cows. These estimates rely on mathematical models developed to estimate emissions based on various factors. Because enteric methane emissions are highly influenced by diet, the models need to incorporate the effect of various diets or feed ingredients. Total mixed rations fed to California cows have not been widely surveyed. To improve the accuracy of the inventory and determine the level of uncertainty, California-specific feed data must first be collected and used in the emissions model.

USDA's 2012 Agricultural Census indicates there are at least three adult milking cows for every beef cow in California. With approximately 1.8 million milking head, California has the highest number of milking cows in the nation. Due to the large dairy population in the state, feed and enteric methane emissions from dairy cows should be the focus of this research (with beef cattle feed also examined and modeled, though to a lesser degree).

The methodologies to estimate methane emissions from enteric fermentation developed by the U.S. EPA for the Inventory of U.S. Greenhouse Gas Emissions and Sinks form the basis of California's inventory. Dairy feed formulation has changed in the past decade as a consequence of changes in feed price, including the rising price of corn grain due to the large amount of corn used to produce ethanol. California-specific data are especially important when feed compositions are changing with economic conditions.

A significant amount of enteric fermentation research exists, from methanogenic bacterial studies and modeling to diet and breed effects. This proposal focuses on modeling California-

specific data and scenarios, which does not currently exist. This research does not collect emissions samples from enteric fermentation in part because many animals have already been directly measured in other studies, and the limited budget and scope of this work precludes measurements of a sufficient number of ruminant animals. Obtaining California-specific feed data is key to leveraging existing modeling work and tailoring models to California scenarios.

III. SCOPE OF WORK

- Literature review of applicable enteric fermentation research on dairy cattle and beef cattle.
- Collect real world data to estimate California's composition of feed rations and how these various diet formulations impact enteric methane emissions; estimate statewide methane emissions from enteric fermentation.
- Develop a suite of equations similar to those published in Global Change Biology (Moraes et al. 2014) but using data that is most specific to California.
- Compare the methane emission estimates based on new models and the methodologies used by US EPA. Make recommendations of how best to update ARB's current methodology.

IV. DELIVERABLES

- Quarterly progress reports and conference calls;
- Draft final report;
- Peer-reviewed publication(s), as appropriate;
- Final report and research seminar in Sacramento;
- All data and analyses generated through the course of this project;
- Additional deliverables to be determined in consultation with ARB staff.

V. TIMELINE AND BUDGET

It is anticipated this project will be completed in 24 months from the start date. This allows 18 months for completion of all work through delivery of a draft final report. The last 6 months are for review of the draft final report by ARB staff and the Research Screening Committee (RSC), modification of the report by the contractor in response to ARB staff and RSC comments, and delivery of a revised final report and data files to the ARB. The estimated budget for this project is \$100,000.

References

Moraes, L. E., A.B. Strathe, J.G. Fadel, D.P. Casper and E. Kebreab. 2014. Prediction of enteric methane emissions from cattle. Global Change Biology, in press.

USDA Agricultural Census 2012:

http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/California/st06_1_012_013.pdf

USEPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2012 (April 2014):

<http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#fullreport>