State of California
AIR RESOURCES BOARD

Characterize Physical and Chemical Properties of Manure in California Dairy Systems to Improve Greenhouse Gas (GHG) Emission Estimates

RESEARCH PROPOSAL

Resolution 15-30

July 23, 2015

Agenda Item No.: 15-6-2

WHEREAS, the Air Resources Board (ARB or Board) has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2794-283, titled "Characterize Physical and Chemical Properties of Manure in California Dairy Systems to Improve Greenhouse Gas (GHG) Emission Estimates," has been submitted by the University of California, Davis, for a total amount not to exceed $151,423;

WHEREAS, the Research Division staff has reviewed Proposal Number 2794-283 and finds that in accordance with Health and Safety Code section 39701, research is needed to evaluate existing information on dairy practices as they may relate to GHG production, and to develop and deploy field data collection to substantiate modeling assumptions (e.g., volatile solids in lagoons) on selected commercial dairies; and

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee has reviewed and recommends funding the Research Proposal.

NOW, THEREFORE BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and staff and approves the Research Proposal.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the Research Proposal as further described in Attachment A, in an amount not to exceed $151,423.

I hereby certify that the above is a true and correct copy of Resolution 15-30 as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Characterize Physical and Chemical Properties of Manure in California Dairy Systems to Improve Greenhouse Gas (GHG) Emission Estimates"

Background

Methane (CH_4) and nitrous oxide (N_2O) are important greenhouse gases produced by dairy production systems. The current ARB inventory calculates that more methane (CH_4) is emitted through manure processes than enteric emissions. Key assumptions used by the United States Environmental Protection Agency (U.S. EPA) to estimate greenhouse gas (GHG) inventory include: 1) bacteria generate methane at 75 percent of maximal optimum conditions (on average, year round); 2) 59 percent of California milking cow volatile solids go to anaerobic lagoons; and, 3) 20 percent to "liquid/slurry" where 33 percent of optimal methane generation is realized. Animal housing dictates to a large extent the potential manure collection and animal welfare options available to dairy managers. A number of key parameters were evaluated prior to building each existing facility: number of animals at the facility (initially and at expansions), labor available to move cattle into and out of the milk parlor, climate (temperature, precipitation, wind), animal welfare concerns, and land available for the production area footprint. Once housing is in place, modification of manure collection, storage, and treatment practices can be incredibly expensive to fit into the existing physical footprint of the operation. Some studies have surveyed dairy producers in the Central Valley to identify manure management practices. Manure flow charts were developed for drylot and freestall dairy operations. To date, the number of facilities or cattle with manure collected in freestall or drylot systems has not been analyzed. Although spreadsheets exist to estimate volatile solid flows through dairies for purposes of designing anaerobic digesters, no actual data have been collected to validate volaile solid flow assumptions for California.

Objective

The objectives of the study to evaluate existing information on dairy practices as they may relate to GHG production, and to develop and deploy field data collection to estimate volatile solids and nitrogen excretion from animals and flow of volatile solids and nitrogen through dairy production facilities on up to six commercial dairies. The outcome of this research will identify if the current assumptions used for ARB inventory for manure emissions are reasonable and provide values or ranges of values for ARB consideration if current methods do not represent industry practices.

Methods

Real world surveying of manure management pathways (including volatile solids at each stage of management) will be conducted to substantiate or refute modeling assumptions. Other factors such as nitrogen will also be tracked and measured with the intent to better inform the N_2O inventory. Dairy farms will be selected to represent the various types of manure management systems, including scraping, flushing, solids separation, lagoon storage, covered lagoon digestion, and solids digestion, etc. Representative samples of manure will be taken from each manure pathway to determine the nutrient flow at each stage of management.

Expected Results
The results will be compared to U.S. EPA assumptions about volatile solids in manure management systems modeled according to farm-size, temperature, and other modeled factors related to methane production. If current assumptions used by ARB for GHG inventory purposes do not reflect industry practices or the physical/chemical environment in which the manure is residing, alternative values or ranges of values will be suggested.

Significance to the Board
If manure methane is shown to be larger or smaller than the existing U.S. EPA modeling, then ARB will be better able to prioritize dairy manure methane mitigation concepts as well as better calculate the costs and benefits of methane capture or abatement.

Contractor:
The University of California, Davis

Contract Period:
24 months

Principal Investigator (PI):
Deanne Meyer, Ph.D.

Contract Amount:
$151,423

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
The University of California, Davis (UCD) as an institution is uniquely capable to perform this research, given previous experience of its researchers and the database and resources they hold. Dr. Deanne Meyer has worked for decades with dairy manure pathways from a scientific perspective including multiple publications as well as via UCD Cooperative Extension. She is familiar with sampling protocols and dairy farm operations, an important combination for on-farm research.

Prior Research Division Funding to the University of California, Davis:

Year	2014	2013	2012
Funding	$ 2,249,136	$ 1,131,716	$ 4,949,363

BUDGET SUMMARY

The University of California, Davis

Characterize Physical and Chemical Properties of Manure in California Dairy Systems to Improve Greenhouse Gas Emission (GHG) Estimates

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	49,956	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	51,000[1]	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	25,000[2]	
9.	Analyses	$	0	
10.	Miscellaneous	$	12,871[3]	
	Total Direct Costs			$ 138,827
INDIRECT COSTS				
1.	Overhead	$	12,596	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$ 12,596
TOTAL PROJECT COSTS				**$ 151,423**

NOTES

[1] air transportation 4 scientists @750 each $3000; ground transportation 25,000 miles private car *$.575/mi $14375; subsistence for graduate student and travel to scientific meetings $11,125; lodging and meals (Robinson and Meyer for Monthly farm needs) $250/trip * 45 trips/person * 2 people $22,500;

[2] This includes fleet services vehicle use, probes replacement, shipping samples for testing, sampling supplies, analysis of dairy lagoon samples, and publication costs;

[3] This is Graduate Student Researcher tuition fees.