

State of California  
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-61

December 9, 2009

Agenda Item No.: 09-10-1

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat climate change, pursuant to Health and Safety Code sections 38700 through 39705;

WHEREAS, a research proposal, number 2682-265, entitled "Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

Proposal Number 2682-265, entitled "Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," has been submitted by the University of California, Davis for a total amount not to exceed \$82,000.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 38500, hereby accepts the recommendation of the Research Screening Committee and approves the following:

Proposal Number 2682-265, entitled "Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems," has been submitted by the University of California, Davis for a total amount not to exceed \$82,000.

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 effort proposed herein, and as described in Attachment A, in an amount not to exceed \$82,000.

I hereby certify that the above is a true and correct copy of Resolution 09-61, as adopted by the Air Resources Board.

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Lori Andreoni, Clerk of the Board

## ATTACHMENT A

### “Assessment of Baseline Nitrous Oxide Emissions in California’s Dairy Systems”

#### Background

Nitrous oxide emissions from agricultural soils have been estimated using a bottom-up, emission factor approach. However, production of N<sub>2</sub>O from agricultural soils is a microbial process, regulated by numerous environmental factors such as temperature, soil moisture content, and soil organic matter content. As a result, N<sub>2</sub>O fluxes from soils are highly irregular both spatially and temporally, and can change extensively with crop, soil, or management practices. In intensively managed cropping systems, spikes of N<sub>2</sub>O fluxes are often coupled with soil management events such as application of nitrogen fertilizers, irrigation/drainage, tillage disturbance, and incorporation of plant residues. Precipitation can also induce substantial N<sub>2</sub>O fluxes. Therefore, field measurements are required to accurately characterize N<sub>2</sub>O emissions from agricultural soils. There have been extensive studies performed measuring N<sub>2</sub>O fluxes from crop and range land, but data are sparse in California’s cropping systems, especially for those with inputs of dairy waste. Dairy waste is applied to approximately 400,000 acres of irrigated forage cropland in California, producing one of the highest annual throughputs of nitrogen of any cropping system in the world, leading to potentially substantial N<sub>2</sub>O emissions. In addition, the soil conditions in the cropping systems receiving dairy waste tend to be more conducive to N<sub>2</sub>O production because this N-containing waste has high levels of organic compounds, which could enhance both nitrification and denitrification - the major processes producing N<sub>2</sub>O in soils.

#### Objective

The goal of this project is to determine N<sub>2</sub>O emissions in typical California forage cropping systems receiving dairy lagoon waste and manure. The N<sub>2</sub>O fluxes will be measured in three forage crops to: (1) determine the seasonal and annual emission rates of N<sub>2</sub>O; (2) calculate crop system-specific N<sub>2</sub>O emission factors; and (3) identify key environmental conditions that affect N<sub>2</sub>O emissions.

#### Methods

The project is part of a coordinated effort with the California Energy Commission (CEC), and California Department of Food and Agriculture (CDFA) to determine baseline emissions of the greenhouse gas N<sub>2</sub>O in the State. The project will conduct field experiments to monitor N<sub>2</sub>O fluxes from corn forage fields in three selected dairy farms located in the San Joaquin Valley. Either PVC or stainless steel chambers will be placed in the fields and N<sub>2</sub>O emissions will be monitored by taking periodic air samples from the enclosures and injecting them into a gas chromatograph for analysis. Sampling will be taken during a one year period. The sampling frequency will vary, depending upon the expected N<sub>2</sub>O fluxes, and will be more intensive after manure and lagoon water inputs and during rainfall events. Short-term time series of N<sub>2</sub>O fluxes will be monitored to characterize diurnal variation of emissions. Ancillary data on related environmental and crop parameters such as soil nitrogen availability, soil water content,

soil organic carbon content, soil and air temperatures, and crop yields will also be collected to facilitate data interpretation and determine their impacts on N<sub>2</sub>O emissions. Finally, silage corn-specific emission factors will be calculated based on the N<sub>2</sub>O emission data and will be used, together with those obtained from other cropping systems, to develop a more realistic estimate for baseline N<sub>2</sub>O emissions from California agricultural soils.

**Expected Results**

The emission rates of N<sub>2</sub>O measured in this project and other projects will be used to develop California-specific N<sub>2</sub>O emission factors for estimating baseline N<sub>2</sub>O emissions from agricultural soil management in the State. These results are expected to reduce uncertainties associated with the current N<sub>2</sub>O inventory of California.

**Significance to the Board**

The California Global Warming Solutions Act of 2006 requires the State to reduce greenhouse gas emissions to 1990 levels by 2020. Agricultural soil management is recognized as the largest source of N<sub>2</sub>O in California. However, there are enormous uncertainties in both the estimate of baseline N<sub>2</sub>O emissions from agricultural soils and reductions achievable from potential mitigation measures. This project will help ARB to improve the estimate of baseline N<sub>2</sub>O emissions and provide a basis for the development of a mitigation target.

**Contractor:**

University of California, Davis (UCD)

**Contract Period:**

24 months

**Principal Investigator (PI):**

William R. Horwath, Ph.D.

**Contract Amount:**

\$82,000

**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 research team of this project consists of known experts in the state on nitrogen management and cycling in agricultural ecosystems. The investigators have been involved in field studies of nitrogen fate, including N<sub>2</sub>O, in many projects. Dr. Horwath is a professor in soil biogeochemistry and has published extensively in the leading journals regarding soil processes of nutrients management. He is currently engaged in several other projects involving monitoring of N<sub>2</sub>O from alfalfa, wheat, rice, lettuce, and tomato fields.

**Prior Research Division Funding to UCD:**

Year	2008	2007	2006
Funding	\$915,193	\$935,020	\$1,684,890

**BUDGET SUMMARY**

Contractor: University of California at Davis

"Assessment of Baseline Nitrous Oxide Emissions in California's Dairy Systems"

**DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$	60,776
2.	Subcontractors	\$	0
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	5,940
5.	Electronic Data Processing	\$	0
6.	Reproduction/Printing	\$	254
7.	Mail, Phone, and Fax	\$	0
8.	Materials & Supplies	\$	7,356
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>219</u>

Total Direct Costs \$74,545**INDIRECT COSTS**

1.	Overhead	\$	7,455
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>

Total Indirect Costs \$7,455**TOTAL PROJECT COSTS** **\$82,000**