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

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Project Funded by California Air Resources Board
Start date: July 2010

Objectives

- Determine N_2O emissions and N_2O emission factors in forage crop systems receiving dairy lagoon water, corral manure and inorganic nitrogen as fertilizer

- Contribute N_2O emission data from dairy systems to calibrate and validate biogeochemical models

Background

- Dairy forage systems have high N throughputs:
  - ✓Inputs: 600 - 700 kg N ha^{-1} $year^{-1}$(General Order rules)
  - ✓Dry manure (corral scrapings), lagoon water, and synthetic N
  - ✓Outputs: 350 - 600 kg N ha^{-1} $year^{-1}$; 2 - 3 crops per year

- Potential for substantial N_2O emissions
  - ✓High N inputs and large residual nitrate pools
  - ✓Anaerobically stored manure contains volatile fatty acids,
  - ✓ which may stimulate denitrification

Summary of Tasks

- Select sites
- Account for annual nitrogen inputs
- Measure N_2O emissions
- Calculate annual N_2O emissions and emission factors
- Measure chemical and physical factors influencing N_2O flux
- Report

Task 1. Select Site

Cropping systems:

- Three dairy farms in Stanislaus and Sacramento County
  - ✓Vary in soil type
  - ✓Type of N inputs typically used:
    - *Dairy waste lagoon water (irrigation water)*
    - *Solid dairy waste (spring & fall applications)*
    - *Synthetic N (supplemental)*

  - ✓No-till, conventional tillage
  - ✓Silage corn, Sudan grass, wheat, oats, Triticale

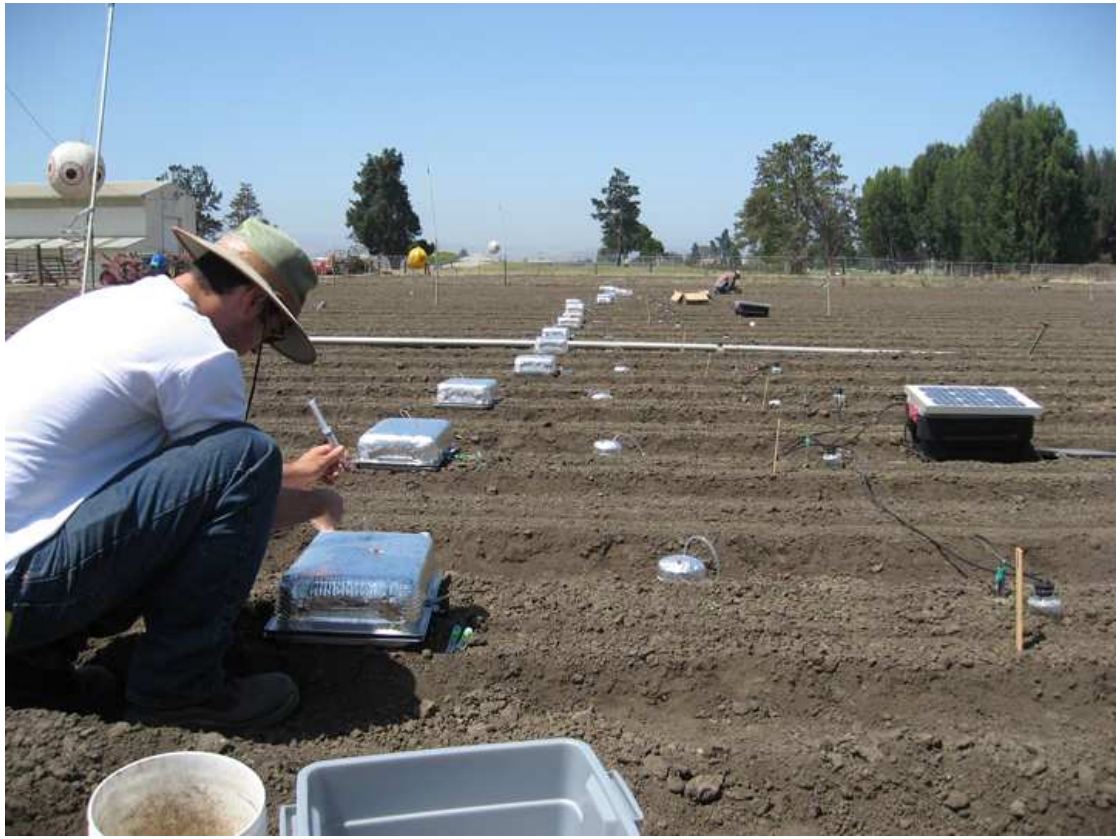
Task 2. Account for Nitrogen (N) Inputs

- Measure N in dairy waste lagoon water mixed with the applied irrigation water
- Measure N applied as corral manure
- Account for additional N applications in the form of synthetic fertilizers

Task 3. Measure N_2O Flux in Fields Receiving Dairy Waste

- **Event-based sampling** (at least 5 events):
  - ✓After manure application and irrigation
  - ✓First rainfall in the fall
  - ✓During the rainy season

- **Control treatments** will not receive N input (irrigation water only *vs.* irrigation water mixed with dairy waste lagoon water).



Static chamber technique will be used to collect air samples and measure N_2O flux from dairy forage fields

Task 4. Annual N_2O Emissions

- Annual N_2O emissions will be estimated based on the event-based measured emissions (e.g. total N_2O emissions during an irrigation event until N_2O fluxes subside to background levels).

- N_2O emission factors (N_2O-N emitted/N applied) will be calculated for total N_2O emission and for the difference in N_2O-N emitted between fertilized and control treatments.

Task 5. Soil Physical and Chemical Factors Affecting N_2O Flux

- Environmental variables:
  - ✓Soil moisture (water-filled pore space)
  - ✓Inorganic N concentrations
  - ✓Soil and air temperature
  - ✓pH

- The above ancillary variables, as well as the NO_x flux results, will be used to characterize the environmental conditions influencing N_2O emissions

- The ancillary data will be used to calibrate and validate models of N_2O emission.

Task 6. Report

- Quarterly progress reports
- Final report
- Stakeholder review
- Research Screening Committee (RSC) review

Timeline (revised, 6 month delay reflected)

Task 1: Select sites
Task 2: Measure manure & lagoon water N inputs
Task 3: Measure N_2O emissions
Task 4: Calculate annual emissions
Task 5: Measure ancillary variables
Task 6: Prepare final report

2010	MONTH	1	2	3	4	5	6	7	8	9	10	11	12
TASK													
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2011	MONTH	1	2	3	4	5	6	7	8	9	10	11	12
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2012	MONTH	1	2	3	4	5	6	7	8	9	10	11	12
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