4-178

January 17, 2008

Ms. Tessa Chadwick, CIG Manager
USDA NRCS, Financial Assistance Program Division
1400 Independence Avenue, SW, Room 5237-S
Washington, D.C. 20250

Dear Ms. Chadwick:

Attached is CDC's final report for the CIG Project "Dairy Lagoon Management Systems" dealing with Purple Sulfur Bacteria. The report addresses each item in the original agreement plus a final financial status report and a summary of project expenditures.

In addition to this final report to you, we have maintained a three ring binder with documentation about the project including outside contracts, conservation plans, etc. We also plan on producing a popular report about our project containing six to ten pages which we will share with dairy producers, agencies, consultants and the public. As mentioned in the final report, we have produced 300 copies of a video on our project. Included in this mailing is a copy of that video. We have reserved another 75 copies of the video for your use, if desired.

Mentioned in the report was a final workshop/conference to be held in early April 2008. Scientists will present final data of our project at this workshop. We hope you will be able to attend.

Finally, we would like to thank you and NRCS for the opportunity for CDC to administer this grant. In our visit to Florida in July 2007, we noticed many good projects and saw results of good things happening throughout the country. We feel our project ranks with the best.

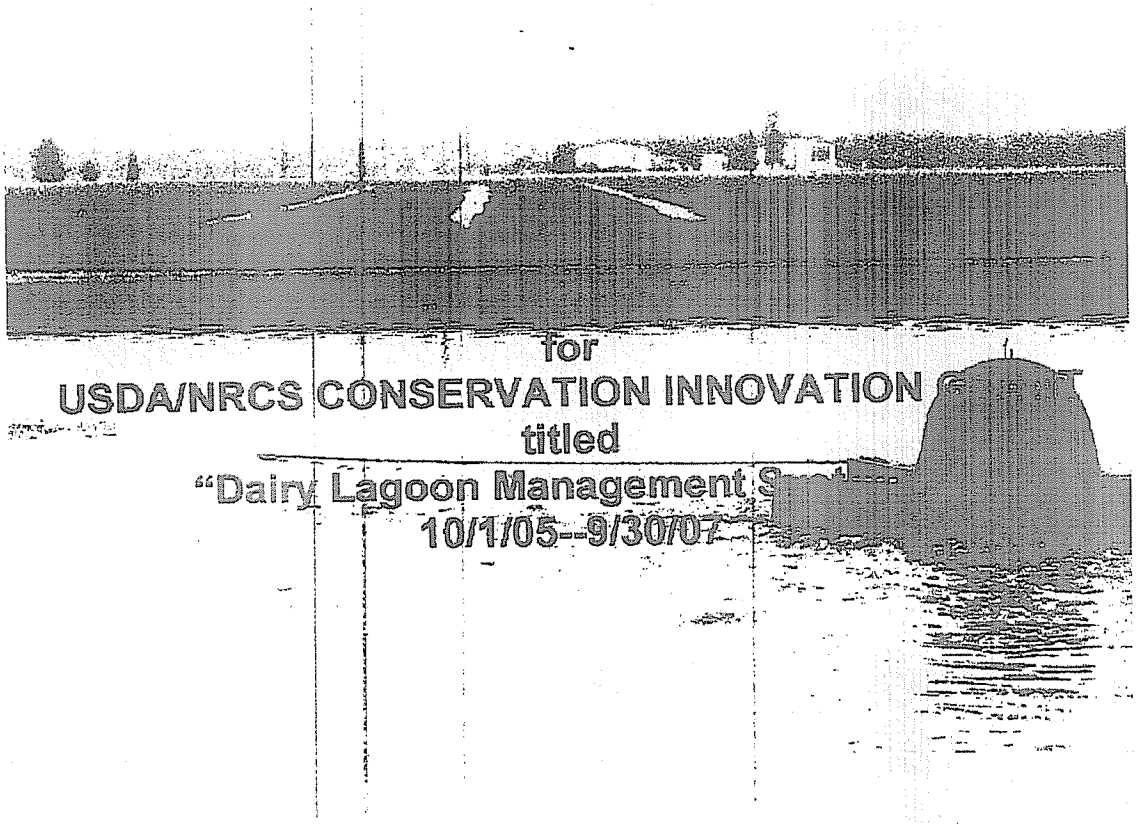
Thanks again for the opportunity and for all your help through the project. If you have questions concerning this final report, please feel free to contact me or Gary L. Bullard, Project Manager.

Sincerely,

Kevin Abernathy

Kevin Abernathy,
Executive Director
California Dairy Campaign

Attachments



for
USDA/NRCS CONSERVATION INNOVATION
titled
"Dairy Lagoon Management S
10/1/05--9/30/07

California Dairy Campaign
2881 Geer Rd., Suite D
Turlock, California

FINAL CIG REPORT

Listed below are summaries on each deliverable item that was listed in the initial agreement signed between CDC and NRCS. These summaries include project activities, funding requested, funding expended, results, and the potential for technology transfer. In addition to the summaries, a three ring binder containing personal notes, documentation, and other significant information on the project is maintained by the Environmental Project Manager of CDC. List of deliverables:

1. **Prepare RMS Plans on 10 dairies and install three new dairy waste management technologies on these farms.**

CDC personnel met and discussed the CIG concept to potential dairymen. After visiting numerous dairies, eleven were selected to participate in the project. These eleven dairies were located in five different counties within the San Joaquin Valley. Management objectives were discussed with each dairyman and a conservation plan was prepared. In all plans, efforts to protect all resources including soil, water, air, plants and animals were discussed with the dairymen. Most of the dairymen were already doing a good job of management on their farms. The three systems evaluated included no mechanical separator, mechanical separator with circulators, and gravity retention ponds with circulators. Efforts were made during the project to retrofit existing dairies with a focus on good management as opposed to making major changes in structures and facilities.

Plans prepared included solid separators, circulators, nutrient management, pesticide management, irrigation water management, irrigation water return systems and flow meters. Soil testing, plant tissue testing and water testing were all part of nutrient and irrigation water management. Two of the dairies were organic producers. Animal health and comfort is paramount to the dairymen and all manage their herds accordingly. Water misters, fans, clean lanes and bedding, fresh water, fly control, proper nutrition, and sanitized milking parlors are all part of the dairymen's daily operation and management. The average dollar spent on each dairy was $79,757.36 with 50% being paid by the dairymen. Five of the eleven dairymen were first time EQIP participants.

This grant focused on improvement or changes in management on the dairies primarily in ways to induce phototrophic anaerobic bacteria (PSB) in the lagoons. This could be potentially achieved in several ways:

- Increase lagoon size with emphasis on increased surface area (this option was not considered doe to the lengthy process and cost of lagoon construction)
- Reduce amount of solids reaching lagoon
- Expose existing phototrophic anaerobic bacteria in the lower depths of the lagoon by circulating or mixing the water

- Reduce the depth of water in the lagoons to allow more light penetration
- Add fresh water to system following any lagoon water removal such as irrigation

2. **Evaluate the environmental, social, and economic effects of dairy waste management techniques through collection and analyses of at least 500 samples.**

In order to document changes in management, several contracts were let to evaluate environmental, social and economic effects. Over 840 samples were collected and analyzed during the project. These include:

- Denele's Lab—50 samples of water profiles. These samples were collected early in the project on several dairies for baseline information.
- Denele's Lab—75 samples on 120 day corn silage test. These samples were collected to compare traditional black lagoon water with red water (PSB) lagoons from two dairies with a control of irrigation district water with commercial fertilizer added was used as well. A 120 day corn silage test was performed with samples taken periodically from soil, plants and water leachate. Generally, the red water out performed the black water with no significant difference from the control. Germination rates and soil condition were improved when compared with the black water. See final report for more details.
- Denele's Lab—576 samples on water chemistry. These samples were collected from various locations in the waste stream on 8 different dairies and tracked for a year. Preliminary results help explain seasonal changes in red water. Significant differences in accumulated waste in lagoons were evident during the winter months. Four of these dairies are the same four dairies used in the ARS study on microbial changes. Preliminary data correlates, however, final results will be available in the spring of 2008.
- Fresno State University—40 samples, air quality flux chambers. These samples taken using the flux chamber came from three traditional black water lagoons and three red water lagoons with an effort to measure air emissions. Preliminary data indicates that the red water lagoons do reduce odors and emissions of VOC's. Final data will be available in the spring of 2008.
- Agricultural Research Service—60 samples on microbial changes. These samples were collected and analyzed to determine species diversity and population change in lagoons on four different dairies where systems were installed. Monthly samples were taken. Preliminary results indicate that additional capacity is probably needed on most dairies to achieve purple sulfur bacteria (PSB) in their lagoons year round. This is apparently due to loading up in

winter months due to a lack of irrigation from dairy lagoons. This preliminary data also correlates with preliminary findings in the chemical samples taken. Final results will be available in the spring of 2008.

- Agricultural Research Service—20 samples on photosynthetic amendments. These samples were taken on two dairies that were involved in an effort to establish red water with amendments as opposed to creating an environment for natural production and reproduction. The amendments did not result in red water but did break down solids in the bottom of the lagoons. More study is needed on the effects on solids accumulation and break down.
- Sacramento State University—20 samples on water chemistry profile. These samples were used in conjunction with a company promoting solar powered circulators. Two lagoons were used on one dairy and the results were inclusive due to vast changes in the depths of the lagoon from irrigation and the solar company backing out of the effort.

Raw data is being maintained by the CDC Environmental Project Manager. At present, final data is still being analyzed and will be available in the spring of 2008. .

3. **Disseminate results to at least 400 producers through workshops targeting those who have not traditionally received assistance from NRCS.**

Six workshops/field days were conducted during the grant period. Two of these workshops were conducted in conjunction with conservation tillage which broadened the attendance group from traditional dairymen to other producers. One workshop included invited speakers from several universities familiar with purple sulfur bacteria. One of the workshops included a tour of several dairies, three of which were in the project. One workshop focused on the use of the Nasal Range Finder and was attended by various agencies personnel, consultants and dairymen. In the Spring of 2007, a public television station in Fresno, CA presented a special on air quality within the San Joaquin Valley in California. Part of the presentation highlighted purple sulfur bacteria as an effective tool in the fight in air pollution in the Central Valley of California. Numerous articles have been published on the CDC website. Another article in a dairy magazine featured our grant. Other magazines featured dairymen involved in our project. The CDC Environmental Project Manager has been requested by the editor of The Journal of Soil and Water Conservation to write a feature article with photos. This article will probably be published in the summer of 2008.

4. Explore the possibility of modifying NRCS FOTG practice standards and specifications based on field trials.

During the project, not only was the 11 dairies involved in the grant observed but numerous other dairies/lagoons were visited during the three year effort. Significant data was collected through contracts with numerous vendors (see section 2). General comments presented below will include both anecdotal and documented data; however, final recommendations will be based on the final results of studies. Numerous observations during the grant indicate that more lagoon volume is needed to produce and maintain PSB than now exists in NRCS practice recommendations. Approximately 25 to 50% more capacity is probably needed to support a phototrophic anaerobic lagoon. Design depth should not exceed 12 feet. Shallow depths are even more suitable to support PSB and if adequate land area is available, depths less than 12 feet are even more desirable. Since sunlight is necessary to PSB, efforts to maximize exposure to sunlight, is important to consider. PSB can be established in ponds in less than 8 to 12 feet without circulation. Deeper ponds need to be circulated. During the grant it was noted that PSB became established on its own without circulation. These observations were noticed on (1) new lagoons with minimal loading, (2) cleaned out lagoons filled about one half full with fresh water, (3) shallow water pooling in shallow ditches or standing water on dairies where anaerobic conditions existed along with adequate sunlight, and (4) in older lagoons with minimal loading.

Two major types of equipment were used in the project and appear as necessary components to achieve PSB in most dairy lagoons. These are mechanical separators or gravity retention ponds and circulators. Mechanical separators used on farms were either Albers or US Farm System brands. These separators have been in use for many years and both seem to do an adequate job if maintenance is performed. The other major component involved was circulators. These devices are not to be confused with aerators which supply oxygen to the top layer of a pond by splashing or agitating water at the surface. Circulators are devices that mix or circulate the water with minimal agitation. As mentioned circulation is a key component in phototrophic, anaerobic lagoon management, especially in lagoons with depths of 8 feet or more. Most lagoons are currently designed at depths that range from 12 to 24 feet deep. Three brands of circulators were used in the project which generally operated 24 hours per day. These were (1) Circul8 made by Nutrient Recycling in Washington State. About 25 of these machines were used in the project, half of which had been in use for 4 to 5 years. This brand out performed the other two brands in the project. These sturdy built machines were the most expensive of the three at about $9,000 each but needed little or no maintenance other than lubricating one to two times per year. (2) Pond Mill Circulators are made by Little River Pond Mill in Canada. About 75 to 80 of these machines were purchased at a cost of $5,000 each. These machines when in operation performed okay but had very high maintenance needs. Over half of the machines failed mechanically

and had to be repaired at least once. Four of the machines sank to the bottom of the lagoon after twine cut through vulnerable part of the circulator. The manufacturer of these machines was very uncooperative and unwilling to replace parts in a timely manner if at all. This unforeseen situation created an unnecessary hardship on the dairymen and to CDC. CDC and the affected dairymen had to pay for parts and labor in order to repair the machines. The replacement parts were purchased from another source other than the original supplier. This brand's performance was unacceptable due to high maintenance needs and poor warranty. (3) Blue Frog Circulators are made by Absolute Aeration in Lexington, Nebraska. Only four of these machines were purchased late in the project but seem to be performing very satisfactorily. These machines cost about $7,000 per unit and are designed to mix water on the surface or at varying depths. Maintenance on these machines has been acceptable.

A final recommendation based on results of studies within the CIG will be presented to California's State FOTG Committee as soon as possible. As of 12/31/07 no date had been set for the FOTG Committee Meeting but one is expected to be conducted in late spring or early summer of 2008.

5. **Transfer technology throughout State and beyond through workshops and video.**

Numerous workshops were conducted during the granting period. See paragraph #3 above on workshop details. Near the end of the three year project, a video was produced to be used in technology transfer. Four dairies were selected to be included in the video which are Verburg & Son Dairy, Faria Dairy, Inc., Hilltop Holsteins and Magneson Dairy. The video length is slightly over 26 minutes. Over 300 copies of the video have been produced. Seventy-five copies will be made available to the NRCS National Office for their use and distribution. Ten copies will be provided to California NRCS State Office. Other copies will be provided to partners and cooperating agency personnel. Approximately 75 copies will then be available for servicing future requests and will be held by CDC.

A final two day conference is scheduled in April 2008. This conference will feature presentations on the final results of the CIG study. Those who contracted for services/studies will present their data. Other speakers within and outside the state will speak on various issues now facing the dairy industry. Part of the session will be focused on individual dairy participation (from 10:30 a.m. to 2:30 p.m.). Over 120 attendees are expected. An evening BBQ at a local dairy will conclude the first day of the meeting. A summary of the workshop will be forwarded to the GIG Manager.

For more information on this report, please contact:
Gary L. Bullard, e-mail glbullard@comcast.net

PROJECT EXPENDITURES

	Local	Federal	Total
Contracts with Dairies	$438,669	$438,669	$877,338
Supporting Contracts	158,132	148,132	306,264
Personnel	270,533	183,570	454,103
Travel	36,046	24,624	60,670
Equipment	4,595	4,629	9,224
Supplies	4,551	1,628	6,179
Reimburse some items	0	46,500	46,500
Other	12,361	9,335	21,696
Workshop	13,500	26,500	40,000
NRCS FOTG	3,500	13,500	$17,000
Final report NRCS NHQ	22,100	46,900	$69,000
Popular Report and distribution	27,500	47,500	$75,000
TOTAL	**991,487**	**991,487**	**1,982,974**
GRANT ALLOCATION =$1,000,000			
FUNDING REQUESTED=$991,487			
FUNDING EXPENDED=$991,487			