Small Farms Livestock Pollution Prevention

Final Report

CWA Section 319(h) FY 1995
Nonpoint Source Pollution Program Task 500
Contract AG-96-EX-008
OSU Project Account 3-5-90230
Oklahoma Conservation Commission Task #69

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List of Commonly Used Abbreviations

AWMP – Animal Waste Management Plan
BMP – Best Management Practice
CorpComm – Oklahoma Corporation Commission
DEQ – Department of Environmental Quality
EQIP – Environmental Quality Incentives Program
FSA – Farm Service Agency
NPS – Non-Point Source
NRCS – Natural Resource Conservation Service
OCC – Oklahoma Conservation Commission
OCES – Oklahoma Cooperative Extension Service
ODA – Oklahoma Department of Agriculture
ODA-FD – Oklahoma Department of Agriculture-Forestry Division
ODWC – Oklahoma Department of Wildlife Conservation
OSE – Office of the Secretary of the Environment
OSU – Oklahoma State University
OWRB – Oklahoma Water Resources Board
PPP – Pollution Prevention Plan
TMDL – Total Maximum Daily Load
USFS – United States Forestry Service
USFWS – United States Fish and Wildlife Service
USGS – United States Geological Survey
WHIP – Wildlife Habitat Improvement Program

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Executive Summary

This report details OCES activities from 1995 – 2000 in support of the FY 1995 CWA 319(h) Nonpoint Source Pollution Program grant, "Task 500: Small Farms Livestock Pollution Prevention," (OCC Task #69, OSU Account No. 3-5-90230, Contract No. AG-96-EX-008). The grant was administered by OCC. Key personnel at OSU included Project Director Michael D. Smolen (OCES Water Quality Programs Coordinator) and Project Manager Douglas W. Hamilton (OCES Waste Management Specialist).

This project promoted voluntary adoption of pollution prevention practices by livestock producers not permitted in the NPDES system. OCES specifically worked with dairy and poultry producers to adopt manure and nutrient management planning using recordbooks and developed and demonstrated a functional composting system for small horse farms. Surveys were conducted before and after implementation of the project to gauge impact.

Although the official start date of the project was July 1995, agreement between OCES and OCC on the project workplan was not reached until February 1996. The delayed start, plus passage of the Oklahoma Licensed Poultry Operators Act in 1998, resulted in delays between projected and implemented milestones. No cost extensions of the project were granted by OCC in June 1998 and June 1999.

During 1995-1996 OCES began recruiting on-farm demonstrators, conducted in-service training, and began preliminary trials of the composting system. The pre-implementation survey was conducted in 1996-1997. Development of dairy and poultry recordbooks was begun that same year along the lines of books developed under a separate project, CWA Sect. 319(h) FY1997 Task 220, "Swine Waste Management Education," (OCC Task 100). Set-up of dairy and poultry demonstration farms began in Spring 1997 and continued through the life of the project. The recordbooks were revamped based on input of on-farm demonstrations. The continuous bin composting system was proposed for demonstration in 1998. Also in 1998, the Oklahoma legislature began deliberating on what would eventually become the Oklahoma Licensed Poultry Operators Act. Soil and litter testing, record keeping, and educational programs became mandatory for poultry operators. All educational efforts towards poultry were enveloped into the new, nine hours of initial waste management training required by the Act. Records similar to those developed by this project also became mandatory under the Act. Horse farms to demonstrate the continuous bin composting system were located in 1998 and 1999.

Poultry record books were distributed to 481 poultry operators throughout the state of Oklahoma. In the fall of 1999, pollution prevention workshops to train poultry farmers to use their new recordbooks were held in the three counties targeted in this project. One hundred and fifty-two operators in Adair, Cherokee and Delaware Counties attended training sessions. This represents 42% of all registered poultry operators in the target area.

Pollution prevention workshops were conducted in three dairy target areas in Spring 2000. Twenty percent of all grade-A dairy producers in Grady County attended the workshop. Eight percent of the grade-A dairy producers in the Mayes and Rogers Counties target area and 12% of the grade-A dairy producers in the Adair, Cherokee,

and Delaware County target area attended the workshops. Twenty-three dairy record books were distributed throughout Oklahoma.

The post-implementation survey was completed in Spring 2000. According to the survey, 95% of all poultry producers in Adair, Cherokee and Delaware Counties are now using soil testing as opposed to 37% before the project. As a result of this project and its dovetailing into the Oklahoma Licensed Poultry Operators Act, operators keeping records rose from 5% to 88% in the targeted counties. Likewise, 95% of all poultry producers in the targeted counties now use manure sampling.

Soil testing by dairy farmers in the targeted counties rose 20% during the project. Eighty percent of all dairy farmers now use soil testing. The percentage of dairy farmers keeping pollution prevention records remained constant at around 20%. Although we did not see large adoption of records by dairy farmers, the record systems developed during this project are compatible with the requirements of Comprehensive Nutrient Management Plans and Permitted Nutrient Plans that may be required by many dairy farmers under the proposed revisions to NPDES Permit Regulations and Effluent Guideline Standards for CAFOs.

Final Project Report

This report details OCES activities from 1995 – 2000 in support of the FY 1995 CWA 319(h) Nonpoint Source Pollution Program grant, "Task 500: Small Farms Livestock Pollution Prevention," (OCC Task #69, OSU Account No. 3-5-90230, Contract No. AG-96-EX-008). The grant was administered by OCC. Key personnel at OSU included Project Director Michael D. Smolen (OCES Water Quality Programs Coordinator) and Project Manager Douglas W. Hamilton (OCES State Waste Management Specialist).

Introduction

Premise and Scope of Project

This project educated small livestock producers to manage animal waste by applying pollution prevent pollution techniques. Before the project began, considerable effort had been devoted to educating operators of large Concentrated Animal Feeding Operations (CAFOs), but very little effort had been made to address the numerous small operations prevalent throughout Oklahoma.

The northeastern and southwestern parts of Oklahoma have a number of small dairies and feedlots. Stocker-Feeder operations, which prepare yearling cattle for feedlots by grazing on pastures and wheat fields, are concentrated in central and western Oklahoma. Broiler operations, primarily located in northeastern Oklahoma, may have large animal numbers, but due to dry in-house waste handling systems, they are not permitted as CAFOs. Horse farms, including pleasure horses housed on small lots, are scattered throughout the state. Although horses are housed and grazed on very small, partially denuded areas, animal numbers are usually too small for the farms to be permitted as CAFOs.

Considered together, the small dairies, stocker-feeder operations, broiler operations, and horse farms may account for a large portion of the state's non-point source pollution from animal agriculture. Non-regulatory options could be very effective in controlling pollution from small animal farms. These options include soil testing, manure testing, forage testing, nutrient management planning, and record keeping. The project used record keeping as an overarching BMP to coordinate and target the specific problems of pollution prevention. A core group of small farm operators were taught to use pollution prevention handbooks in a series of workshops. A number of demonstration farms showed the positive effects of non-regulatory pollution control measures. For a complete listing of project activities see the workplan included as Appendix A.

The project focused on small, CAFO-exempt livestock operations in two areas: small dairies, broiler farms, and horse farms in northeastern Oklahoma, and small dairies and horse farms in southwestern Oklahoma. In the first year of the project, the target area was narrowed further. Dairy activities were confined to three areas within the state; Grady County in the Southwest; Adair, Cherokee, and Delaware Counties in the Northeast, and Mayes and Rogers Counties, also in the Northeast. Poultry activities were confined to Adair, Cherokee, and Delaware Counties. Horse activities were spread over the entire northeast and southeast extension districts. The northeastern

target area fell predominantly in the Grand Lake and Illinois River drainage areas. The southwestern target area was largely in the Little Washita drainage area.

Pollution Prevention Defined

Manufacturing industries use pollution prevention to reduce the liabilities associated with waste creation. The manufacturing chain is reoriented to become a waste production process. Therefore, the product that the industry intends to sell becomes a beneficial byproduct of the waste production system. Material inputs become costs to producing waste. By applying a pollution prevention perspective to the manufacturing chain, the industry can arrive at true costs of waste reduction alternatives. Pollution prevention concepts are easily applied to animal agriculture. The farm becomes a manure manufacturing plant. Beneficial byproducts are meat, milk, eggs, crops, marketable manure, etc. Inputs include feed, runoff water, electricity and chemical fertilizer. The basic techniques used to achieve pollution prevention in order of greatest cost benefit are:

1. Product Development: turn waste into a sellable product
2. Source Reduction: decrease volume of waste produced
3. Recycling: reuse waste at some other point in manufacturing chain
4. Treatment: transform waste into a more useable product
5. Disposal: safely discharge waste into the environment

Summary of Project Outputs and Milestones

This report details completion of project tasks as defined in the Workplan (Appendix A). The workplan also enumerated a number of Outputs and Milestones that cannot be satisfactorily assigned to any one Task. Completion of Outputs and Milestones are summarized below.

Project Outputs

500.1 Quarterly and Semiannual Reports
- Quarterly and Semiannual Reports were submitted to OCC as required

500.2 Assessment of small livestock producers' knowledge of pollution prevention methods prior to project (pre-implementation survey)
- Initial pre-implementation survey mailing completed September 1996
- Second pre-implementation mailing completed May 1997

500.3 Assessment of project effectiveness in increasing producers' knowledge of pollution prevention methods (post-implementation survey)
- Post-implementation survey mailing completed April 2000

500.4 Small Farm pollution prevention handbooks for dairy, poultry operations
- Dairy handbook completed as described in Task 2
- Poultry handbook completed as described in Task 2

500.5 Twenty-five small producers trained to use pollution prevention handbooks
- 152 poultry producers in Adair, Cherokee and Delaware counties trained
- 13 dairy producers in Adair, Cherokee and Delaware counties trained
- 4 dairy producers in Mayes and Rogers Counties trained
- 5 dairy producers in Grady County trained

500.6 Four cooperators in northeastern Oklahoma demonstrating pollution prevention practices on dairy, broiler and horse farms
- Kelley Dairy
- Chanley Dairy
- Morgan Poultry Farm
- Smith Poultry Farm
- Adams Horse Farm

500.7 Four cooperators in southwestern Oklahoma demonstrating pollution prevention practices on dairy, stocker, and horse farms
- Brown Dairy
- McComas Dairy
- Jeffcoat Horse Farm

500.8 Final Progress Report
- This report is the final progress report

500.9 Develop a simplified composting system for horse producers
- The continuous bin composting system as described in F-1729- *Composting System for Small Horse Farms* was developed under this project.

500.10 Factsheets as needed for dairy, stocker, broiler, and horse operations to supplement the pollution prevention handbooks.
- F-1729 - *Composting System for Small Horse Farms*
- F-2246 - *Using Poultry Litter as Fertilizer*
- F-2248 - *Sampling Animal Manure*
- F-2250 - *Using Stockpiled Feedlot Manure as Fertilizer*

Project Milestones

As can be seen below, most project milestones were reached approximately one year after their proposed completion date. It must be noted that final agreement was not reached between OCES and OCC on the terms of the workplan until Spring 1996, nearly one year after the designated starting time of the project. No-cost extensions of the project were granted by OCC in June 1998 and 1999.

1. Contact producers and identify demonstration farms: July 95 - March 96
   - Initial contacts with Northeast dairy and poultry farms: July 1995
   - Initial contacts with Southwest dairy farms: August 1995
2. Contact commodity groups and publicize project: Nov. 95 – March 96
3. Conduct in-service training for agency personnel: March 95 – March 96
   - Northeast In-service: Pryor, November 15-16, 1995
   - Southwest In-service: Chickasha, March 28, 1996
4. Complete pre-implementation survey: March 96
   - Initial pre-implementation survey mailing completed September 1996
   - Second pre-implementation mailing completed May 1997
5. Set up demonstration farms: March 96 – August 99
   - Morgan Poultry: 1997
   - Smith Poultry: 1997
   - Brown Dairy: 1997

- McComas Dairy: 1997
- Kelley Dairy: 1997
- Chanley Dairy: 1997
- Jeffcoat Horse: 1998
- Adams Horse: 1999

6. Hold public meetings to publicize project and familiarize small livestock farmers bi-annually, with pollution prevention concepts: March 96
   - Northeast Dairy Meeting: Pryor, February 26, 1997
   - Southwest Dairies: Informal publicity conducted by County Extension
   - Northeast Poultry Meeting: Jay, November 4, 1997
7. Complete draft pollution prevention handbooks May 96
   - Draft dairy notebooks delivered to demonstrators: Feb–March, 1997
   - Draft poultry notebooks delivered to demonstrators: Feb, 1997
8. Conduct workshops with small groups of farmers to teach use of pollution prevention handbooks: July 96-Nov 99
   - Delaware County Poultry Workshop: October 26, 1999
   - Adair County Poultry Workshop: November 9, 1999
   - Cherokee County Poultry Workshop: December 14, 1999
   - Adair, Cherokee, Delaware Dairy Workshop: February 16, 2000
   - Mayes, Rogers Dairy Workshop: February 17, 2000
   - Grady County Dairy Workshop: February 23, 2000
9. Conduct field days and tours on demonstration farms seasonally: Beginning July 96
10. Complete post-implementation survey: December 99
    - Post-implementation survey mailed April 2000
11. Prepare Quarterly Reports
12. Prepare Final Report: July 2000
    - Final Report submitted to OCC February 2001

Task 1: Assessment

Pre and Post Implementation Surveys

Conducting the Surveys

Two different approaches were taken with the pre- and post-implementation surveys. In the summer of 1996, survey instruments were mailed to all names on county Extension mailing lists in the Northeast and Southwest Extension Districts. A second mail-out of the same instruments was sent in spring 1997. Surveys were also delivered to poultry growers via their field service representatives. The pre-implementation instrument (Appendix B) asked questions to determine an audience profile, pollution prevention techniques used, knowledge of pollution prevention technology, knowledge of local environmental conditions, and environmental opinions. Returns of the pre-implementation survey are shown in the left hand column of Table B-1. [Tables containing a letter designation can be found in the appendix named by that letter.]

The purpose of the post-implementation survey was to determine how well the project reached audiences in the targeted areas: poultry producers and dairy producers in

Adair, Delaware, and Cherokee counties, dairy producers in Mayes and Rogers counties, and dairy producers in Grady County. A simplified instrument designed to determine audience profile; use of pollution prevention techniques, and knowledge of pollution prevention technology was delivered to these groups. Surveys were mailed to poultry producers using the OSU licensed poultry operators mailing list and to dairy producers on the Kansas-Oklahoma Dairy Newsletter mailing list. Separate instruments were mailed to poultry and dairy farmers (Appendix B). Returns of the post-implementation survey are summarized in the right hand column of Table B-1.

Table B-1 reflects the difference in survey delivery method. Nearly 300 people from 20 counties responded to the 1997 survey. Responses from the 2000 survey are concentrated in the targeted counties. Participation among poultry producers increased in the post-implementation survey.

Audience Profile

Poultry Producers

A detailed profile of poultry producers in Adair, Delaware, and Cherokee counties responding to the pre- and post- implementation surveys is given in Table B-2. [Numbers may not correspond exactly to those in Table B-1. For instance, a farm may have a dairy as its primary enterprise and broiler houses as a secondary enterprise. This farm would appear in Table B-1 as a dairy, but in Table B-2 as a broiler operation.] The 1997 survey sampled mostly broiler producers; whereas, a more diverse group of operators responded to the 2000 survey. Most poultry producers used birds as part of a larger farming operation with cow-calf being the most common secondary enterprise. This conforms to the common assumption that poultry producers recycle nutrients contained in litter through secondary grazing operations.

The ability of broiler producers to recycle nutrients on their own land is analyzed in Table B-3. Only those respondents reporting broiler house capacity and pasture acreage were used in this analysis. The following assumptions were made: 7 flocks of birds were housed in the buildings each year, the birds produced 1.65 tons of litter (1.25 tons clean-out and 0.4 tons cake-out) per 1000 birds sold each year (Collins et al, 1999), the phosphorus content of clean-out and cake-out litter are 69 lbs P_2O_5 per ton and 53 lbs P_2O_5 per ton, respectively. In a normal, low soil test phosphorus situation, producers are allowed to surface apply litter at a rate of 200 lbs P_2O_5 per acre-year (OK-NRCS, 1995). If limited by high soil test phosphorus levels, producers may only spread litter to meet plant phosphorus needs (OK-NRCS, 1995). Less than 33% of all broiler producers surveyed were able to spread poultry litter at 200 lbs P_2O_5 per acre-year on their own land. Far fewer producers will be able to use their own land to spread litter to meet plant phosphorus needs, if it is assumed that pastures uptake phosphorus at a rate of 40 lbs P_2O_5 per acre-year. These results indicate that a large percentage of animal waste management plans for poultry producers in Adair, Delaware, and Cherokee counties must take into consideration trading of poultry litter between multiple landowners.

Dairy Producers

Table B-4 gives a detailed profile of dairy producers in all six counties targeted in the project. Although a smaller number of dairy producers responded to the 2000 survey,

the two populations are similar in terms of education level, numbers of cows milked, and land base. Of the three dairy areas targeted, only those producers in Mayes and Rogers Counties answered the 2000 survey in sufficient numbers to make comparisons between the pre- and post-implementation survey populations. A profile of dairy farmers in these two counties is given in Table B-5. As with the six-county population, the 1997 and 2000 Mayes-Rogers surveys captured responses from similar groups.

Responses by dairy producers to the 1997 survey are sorted by size of milking herd in Table B-6. Although a breakdown of farms by size reveals a diversity of operations in each size category, the following generalizations may be drawn from the data. Overall farm size, in terms of acres of pasture and cropland, increases with size of milking herd. Larger farms have younger, more educated people making management decisions than smaller farms. Smaller herds are milked by part-time farmers who rely on outside jobs for family income or producers with a dairy as part of a larger, more diverse farming operation. Producers who concentrate on the dairy as their sole enterprise operate the larger farms. The smaller sample population collected in the 2000 survey enhanced but did not confirm these generalizations (Table B-7).

A mass balance of nutrients produced by dairy farms reporting both animal numbers and crop acreage was conducted. Dairy farms reporting poultry and swine were not used in this analysis. Phosphorus production (NRCS, 1992) was calculated using all the animals housed on-farm (milk cows, dry cows, replacement heifers, beef cows, beef stockers, horses, and sheep), not just the confined milking herd. This value was used to calculate the distribution of the phosphorus over the reported pasture and crop acreage. The resulting mass balance revealed a major difference between dairy and poultry operations. All dairy farms could recycle phosphorus on their own land in an animal waste management plan with no soil test phosphorus limitations (Tables B-8 and B-9). Seventy-five percent could recycle phosphorus at crop uptake levels. However, the ability to completely recycle nutrients appeared to diminish as milking herd size increased.

Beef Producers

The post-implementation survey was specifically geared to find the impact of training on dairy and poultry producers and did not attempt to re-evaluate beef producers. A good profile of beef producers was obtained from the 1997 pre-implementation survey, however (Table B-10). On the whole, beef producers responding to the survey appeared to be more educated than those identified as poultry or dairy producers. Table B-10 indicates that although beef operations are diverse, cow-calf operations predominate the sampled population. Eighty percent of all farms had a breeding herd present. Beef + poultry operations made up about 10% of the entire population sampled in the Northeast and Southeast Districts. However, in Adair, Delaware, and Cherokee counties, cow-calf + poultry made up 30% of the beef producers. Only one cow-calf operator responding to the survey claimed more than 1000 cows. Ninety-two percent of all cow-calf operators owned less than 200 head. The 6 responding feedlots were also relatively small. All had less than 1000 head with capacities ranging from 35 to 700 head.

Beef operations were similar to dairy farms in their ability to recycle manure nutrients on land owned by the home farm. Using the same type of analysis employed with the dairy

farms data, the vast majority (99%) of beef producers were able to redistribute phosphorus produced on the farm over the reported crop and pasture acreage within the limits imposed by an animal waste management with moderate soil test phosphorus levels. Seventy-seven percent could redistribute phosphorus at plant uptake levels.

Horse Owners

Neither survey was able to identify a population of producers concentrating solely on horses. Only 3 of the 55 horse owners responding to the 1997 survey identified horses as their primary enterprise (Table B-11). However, nearly 20% of all 297 respondents to the pre-implementation survey stated that they had horses on the farm. Respondents who owned horses tended to be the youngest and most educated of all subgroups. A large majority of horse owners own less than 5 horses.

In-Service Training

Two in-service training sessions were conducted for agency personnel as noted in the summary of project milestones. Agendas for the sessions are given in Appendix C. The in-service consisted of both a classroom and a field component. The classroom component covered animal waste management systems, pollution prevention techniques, animal waste management planning, and nutrient management. The in-service concentrated on dairy waste management because dairies have the most complicated waste management systems. If students could apply pollution prevention concepts to dairy farms, they could easy apply them to simpler situations such as poultry farms. A case study approach was taken using a fictitious farm owned by Bos Bovis (Appendix C). Use of dairy slurry pumping equipment was demonstrated during the field component. Calibration of equipment using a soil hydrometer was also demonstrated. [A draft factsheet covering the soil hydrometer calibration method is given in Appendix D.]

The Northeast District in-service took place in Pryor on November 15 and 16, 1995. Training lasted one and half days. The first day was spent in the classroom. The second day was spent in the field demonstrating use of dairy slurry pumping equipment in cooperation with the Wagner County Conservation District. The Southwest District in-service took place in Chickasha on March 28, 1996. The Chickasha in-service consisted of one day of classroom instruction. Participants had previously received instructions on dairy slurry equipment use and calibration at a Grady County Conservation District field day on April 4, 1995.

Participants were given pre- and post- tests before and after the classroom component. Testing instruments were identical for both training sessions and are given in Appendix C. Results of testing are given in Tables C-1 and C-2. Testing covered three main areas of knowledge: waste management systems, manure nutrient utilization, and pollution prevention concepts. Questions on the pre and post-tests were not identical. In general, the audience improved their knowledge base in all three categories. Results of testing are discussed in greater detail in the Measures of Success section of this report.

In addition to the formal in-service training listed in the work plan, a number of additional training opportunities for agency, industry, the news media, and the general public extended the knowledge of pollution prevention for animal agriculture beyond the scope

of the project. A full listing of in-service training related to small farm livestock pollution prevention is given in Table C-3.

Re-Evaluation Based on Audience Needs

A minor re-evaluation of project goals was undertaken in the spring of 1997 based on results of the pre-implementation survey and nearly two years worth of experience working with demonstration farms. The project was redesigned to meet the specific needs of individual audience segments: dairy producers, broiler growers, horse owners, stocker producers and feedlot managers. Project changes were reflected in revisions to the project workplan (Appendix A).

Dairy Producers

The needs of dairy producers were closest to the original design of the project. Dairies produce relatively large quantities of complex solid, liquid, and semi-solid waste. Waste is concentrated on-farm and poses a potential threat to water quality. As was shown in the 1997 survey, most small dairy producers are able to recycle waste nutrients within the cropping systems of the farm. A dairy-specific record book was developed. Emphasis was placed on using pollution prevention techniques to reduce waste volume, matching manure nutrients to crops while maximizing fertilizer cost savings, and balancing waste storage to waste application.

Broiler Growers

The needs of broiler producers differ from those of dairy producers in that most of the nutrients produced on-farm must be recycled outside of the farm cropping system to protect water quality. Also, the Oklahoma Licensed Poultry Operations Act of 1998 mandated nutrient utilization and record keeping for broiler growers in the targeted areas. A poultry-specific record book was developed. Emphasis was placed on record keeping and using pollution prevention techniques to enhance off-site marketing of broiler litter.

Horse Owners

The majority of Oklahoma horse owners are not involved in production agriculture; therefore, pollution prevention techniques are not used by horse owners to reduce costs of production. Many of the techniques have applicability to reduce the potential for water quality impairment, however. Horse owners' greatest needs are pasture management, animal care, and the ability to manage concentrated waste produced when horses are in stalls. A horse-specific record book was not developed. Emphasis was placed on developing an efficient, low-labor composting system for stall waste and demonstrating the system on horse farms.

Stocker Operators

Stocker operations are essentially grazing systems and do not generate a large volume of concentrated waste. Farms are able to recycle nutrients within the grazing system by moving animals and keeping overall stocking rates low. The Oklahoma Cooperative Extension Service has an on-going educational effort in grazing systems. Resources provided by this project were targeted towards small animal production systems that generate concentrated wastes. A stocker specific record book was not developed.

Feedlots Managers
Feedlot managers must deal with concentrated waste in the form of stockpiled semi-solid manure and feedlot runoff. The majority of small feedlots in the targeted area (Grady County) participate in the EPA Region 6 NPDES CAFO permitting system, which makes them ineligible for 319 funds. A feedlot specific record book was not developed. Most of the materials targeted towards dairies using dry lot housing also pertain to small beef feedlots.

Task 2: Pollution Prevention Plans Through Record Keeping

Record Keeping Notebooks

Record keeping notebooks were developed for both dairy and poultry operations. The record books consisted of two portions: record sheets and supplementary materials found in factsheets. Notebooks evolved through all stages of the project as outlined below.

A series of factsheets on animal waste management was initiated with funding from a previous project, CWA Sect. 319(h) FY1997 Task 220, "Swine Waste Management Education," (OCC Task 100). The Small Farm Livestock Pollution Prevention Project was used to continue this process, with emphasis on those factsheet that would facilitate use of dairy and poultry recordbooks, as well as horse manure composters. Factsheets are provided in Appendix D. Factsheets developed during this project included:

- F-1729-*Composting System for Small Horse Farms*
- F-2246-*Using Poultry Litter as Fertilizer*
- F-2250-*Using Stockpiled Feedlot Manure as Fertilizer*
- F-2248-*How to Get a Good Manure Sample*

Building on experiences with the swine waste education project, the draft record sheets consisted of a value-volume worksheet, storage sheets, a field application sheet, and a total farm application sheet. The shape of both record systems evolved over time through an iterative process that included feedback from producers and agency personnel. Tables of contents from both dairy and poultry notebooks are given in Appendix E.

In-Service Training
The dairy record book used in the agency in-service training contained a value-volume worksheet. A Lotus spreadsheet was used to convey volumes during in-service training. The complexity involved in translating volumes produced with the multitude of systems used across the state of Oklahoma made writing a single worksheet impractical.

Field-testing on Demonstration Farms
Field-testing on demonstration farms began in Spring 1997 and lasted until 2000. Some of the feedback received was that producers wanted sheets giving them basic data, i.e., water meter readings, storage pond levels, and a tally sheet of waste applied to different fields. Concern was raised by both poultry and dairy producers that the time and effort

spent on gathering the information did not justify the cost savings they saw in the year-end summary sheet.

Promotional Meetings
Two promotional meetings were given in the Northeast targeted areas in 1997 (February 26 in Pryor for dairies and October 24, 1997 in Jay for broilers). The county extension educator handled promotion with Grady County dairy producers. Emphasis was placed on non-regulatory reasons for keeping records: assessing current position, measuring progress towards a goal, providing basis for sound financial decisions, giving early warning of problems, and protecting against negligence charges.

Producer Workshops

Poultry
Record keeping, soil and litter sampling and use of yield goals became part of poultry operator rules in 1998. All poultry producers producing more than 10 tons of waste were required to attend 9 hours of initial training. To encourage producers to understand their own waste management plan, the initial training included the following modules: soil and litter testing, records required by the regulations, contents of an animal waste management plan, and using an animal waste management plan.

Throughout the state of Oklahoma, 1231 operators have completed all nine hours of initial training. Of these, 361 operate farms in Adair, Cherokee and Delaware Counties. All poultry producers completing the initial training were given the opportunity to receive a poultry recordbook developed by the project, free of charge. The project distributed 481copies to producers throughout the state, including 142 copies distributed in Adair, Cherokee and Delaware Counties. A one-and-a-half hour workshop was developed and offered as continuing education credit to train poultry operators to use the recordbooks. Three workshops, attended by 152 poultry operators, were held in targeted areas in the fall of 1999 (Jay, October 26; Stilwell, November 9; Tahlequah, December 14). Flyers and attendance details for the meetings are given in Table F-1 in Appendix F. There has been demand for the record keeping workshops outside the targeted area. To date, meetings have been given or planned in Stigler, Poteau, and Broken Bow. Attendance at these meetings is estimated at 250 producers.

Dairy
In total, 23 dairy notebooks were distributed to producers in the targeted areas. Three pollution prevention and record keeping workshops were held in the targeted areas during the spring of 2000 (Stilwell, February 16; Pryor, February 17; and Chickasha, February 23). Dairy producers were given the opportunity to take record books home with them after the meeting. Notebook distribution details are given in Table F-2. Eleven notebooks were distributed at the meetings to producers in Adair, Cherokee, and Delaware Counties. Four notebooks were distributed to Mayes and Rogers County producers at the meeting. Three notebooks were distributed to Grady County producers at the meetings. One notebook was given to a producer outside the targeted areas. One of the four demonstration farm operators opted to come to the workshops to augment the one-on-one record keeping training he received.

Task 3: Demonstration Farms

Demonstration farms were set up during a time frame that lasted from 1995 until 1999. Personnel working on demonstration farms in the Northeast District were: Mitchell Fram, Area Extension Water Quality Specialist; Blaine Yrsa and Jason Hollenback, Delaware County Extension Educators; Dean Jackson and Marty Green, Adair County Extension Educators; and Chad Cross and Roger Williams, Cherokee County Extension Educators. Demonstrations in the Southwest District were conducted by: J. Wes Lee, Area Extension Water Quality Specialist, and Ron Justice, Grady County Extension Educator.

Northeast District: Poultry Farms

Morgan Poultry

Keith Morgan runs approximately 95,000 broiler chickens in 5 houses, one of which is an advanced design, total ventilation/light-controlled facility. His poultry production facility is located on 12 acres in the Flint Creek sub-watershed of the Illinois River Basin. He also owned a single breeder facility for a few years, which he has recently sold. He was previously an Extension Cooperator in the Battle Branch project, and is regarded as a leader among poultry producers in the area and is active in issues of poultry contracting and waste management.

Land available for application of waste (over 500 tons annually) is limited, mostly to leased land. Morgan's sales of litter to other producers in the area have increased in recent years. With the assistance of the Conservation District and the EQIP Program, he has installed some pasture and grazing BMPs, notably a streamside fencing project on some of his long-term lease pasture. Project personnel visited with Mr. Morgan a number of times and assisted him in installing a meter to assess water use in his houses. He maintained water use data on individual houses for about one year. He found water use to be generally quite consistent from flock to flock during the same season. He noted that sudden changes in water use rate were good first indicators of problems such a leaks, or even stress on the birds.

He was given information and assistance with a poultry waste record keeping system, and maintained records of applications to his leased land. The project assisted him with soil tests on his lease fields and in one case, potential application fields owned by a neighbor. In addition, his breeder house manure was tested, as well as the drinking water available to the birds, which was high in dissolved manganese.

Over the duration of the project, the exchange of information and views benefited both Mr. Morgan and the project. Mr. Morgan gained a more comprehensive view of animal waste issues, at least in part due to our contacts, but also due to his level of interest and contacts with other sources. In 1998, he spoke about the poultry waste issue at an annual Resource Management Conference in Tulsa, and was well received by attendees.

Smith Poultry

Jack Smith ran approximately 60,000 broilers in three houses south of Colcord, OK, also in the Flint Creek watershed, generating over 300 tons of litter per year. Another cooperator in the Battle Branch Watershed project, both Extension and Conservation

District personnel knew Mr. Smith. As of the fall of 2000, he was in the process of selling his operation. Mr. Smith kept the most complete records of any of the Northeast District Oklahoma cooperators in the Small Farms Project. He used the notebook provided by the project to maintain records of litter applied to individual fields, hay yields, and soil and litter sample results. He felt the system was reasonably easy to use. His interest developed an increased understanding of the waste management system. As a result of this understanding, he quit applying litter to his own fields, which were recording soil P levels from 270 to 940 in 1997 and 1998. As of 1999, he was selling all of his litter to a neighbor. Mr. Smith also allowed the project to use his houses to compare five different litter-sampling methods in 1998.

Northeast District: Dairy Farms

Chanley Dairy

Ed and Nanette Chanley milk 70 - 75 cows on their dairy farm north of the Twin Oaks area in Delaware County. Manure is stored in a covered dry-stack area. The Chanleys have minimal equipment to spread manure, using a front-end loader to spread manure in fields quite close to the dairy barn. He expressed interest in starting to work on the manure system and the project assisted him in making proper decisions using pollution prevention techniques. The Chanleys had NRCS write a waste management plan which called for terraces and diversions to divert fluids to a grass buffer area, and recommended a storage pond if the buffer did not perform adequately. Unfortunately, the Chanleys are ineligible for most cost share programs until they have owned the land for 5 years (2002). The Small Farms Project soil-tested the Chanleys' fields in 1997 and again in 2000. The farm has 158 acres of potential application pastures, but only about 60 acres are low enough in P to apply, according to Eucha Watershed thresholds. Calculations indicate that only about 20 acres would be needed to utilize N and P from the manure. However, if spread on high P and K pastures according to threshold levels, the manure would be worth only about $400 per year. There is a 20-acre brush field that could be cleared. If it tested low in P and K, application to this new area would increase the value of the manure to about $1000 annually.

Mr. Chanley has kept intermittent water use records with a meter installed by the project, providing a good estimate of the amount of liquid that needs to be managed daily. He has seemed favorable to directing all fluids to the pit now used for scrapings in order to better manage water use and holding time, and in using agitator loading equipment along with his tank wagon to haul manure to his best application fields on a daily basis. To this point however, finances have prevented him from doing so.

Kelly Dairy

The Kelly farm is located in Cherokee County, mostly in the Fourteenmile Creek Sub-watershed of Grand River, but some of the operation’s manure may be utilized in the Illinois Basin. The farm owners, Aaron and Jason Kelly, are college graduates. They maintain a milking herd of about 200 cows. Their operation is also one of the few crop farms remaining in Cherokee County.

Current waste management practices on the Kelly farm consist of scraping a partially covered holding area daily into an exposed concrete pit that operates as a "dry-stack area". However, manure in this area is rarely dry and it is difficult to load and spread

with the manure spreading equipment they have. Drainage from this pit, as well as all wash-down water and milk parlor wash water, drains into a small (~0.1a.) storage pond designed by SCS and built by the owners. The pond was originally 8 feet deep and probably designed for 30-60 days of storage. As of 1996, it had not been fully pumped in 5 years. However, it is sometimes partially de-watered to irrigate adjacent fields for sorghum, corn and silage.

The Kellys are considering installing a flushing system, which would require better management of the storage pond system. They had actually purchased, but not installed, a stand tank for flush water. In 1999, the project completed soil testing on all application fields and sampled and tested manure from the dry-stack area. Current status of most fields is sub-adequate in phosphorus, indicating the operation could economically benefit from better on-farm distribution of manure. The demonstration experienced a major setback in 1999 when Aaron Kelly became acutely ill and was hospitalized for over a month, with a long recovery. The demonstration will resume in Spring 2001.

Southwest District: Dairy Farms

McComas Dairy

Chris McComas is a small, full-time dairyman in Minco milking roughly 100 cows. The operation that McComas manages is part of a larger family grain and alfalfa farm. Cows are housed in a dry lot adjacent to the milking center. Manure deposited on the dry lot is scraped, stockpiled and spread. Wastewater from the milking center is stored and treated in a facultative lagoon. Extension personnel developed a stage-storage curve for the lagoon and installed a lagoon sight gauge, took lagoon and manure stockpile nutrient samples, installed rain gauges, installed water meters on the milk center, and tested soil nutrient status on areas he was spreading manure on, as well as adjacent croplands that he planned to spread on.

McComas was given a dairy recordbook, but was not effective in recording data. Extension personnel read the meters on a weekly basis to determine milk center water use.

Brown Dairy

Paul Brown is a full-time dairyman in the Chickasha area. During the time of this project, Brown milked 75 to 150 cows. Cows were housed and fed on a dry lot adjacent to the milk center. Calves, dry cows and heifers were housed in a number of pasture paddocks. Milk center wastewater, as well as manure removed from concrete holding areas with a high-pressure hose, flows into a small settling basin. Manure deposited on the dry lot was scraped, stockpiled and land applied. Runoff from the dry lot and overflow from the settling basin flowed into a one and a half acre retention basin. Extension personnel developed a stage-storage curve for the retention basin and installed a retention basin sight gauge, took retention basin and manure stockpile nutrient samples, installed rain gauges, installed water meters on the milk center, and tested soil nutrient status on all fields on the farm. The settling basin was pumped twice per year using equipment provided by the Grady County Conservation district. The conservation district provided slurry nutrient samples. Extension personnel set up a temporary de-watering system for the retention basin.

Brown was provided with a dairy record book, and became a very diligent record keeper. Through the use of these records, Brown determined that he was already using less water in the milk center than most dairymen. The county extension educator was able to work with Brown to maximize nutrient returns based on his records and soil samples. The Brown farm was used as an example of successful use of pollution prevention techniques at an inter-agency, inter-tribal sustainable agriculture in-service held in Chickasha on June 2 and 3, 1998.

Composting System for Small Horse Farms

As stated under Task 2, the needs of horse farms are different than either dairy or poultry farms. In most cases, horses are owned by full-time farmers who use them for working cattle or for pleasure riding, or by hobby farmers for pleasure riding and breeding. In both cases, five or less horses are housed on most Oklahoma farms and many of these horses spend much of their time unconfined in pastures. The small quantity of concentrated waste produced does not justify the effort necessary to maintain extensive records. That is not to say that small horse farms do not have waste management needs. Although relatively small in quantity, the waste produced by horses housed in stalls poses large risks to animal health and high labor costs to the horse owners. Resources from the Small Farms Project were directed towards demonstrating a low labor composting system for small horse farms.

Composting system development was conducted using project and Oklahoma Cooperative Extension Service funds, as well as facilities of the Oklahoma Agricultural Experiment Station. A series of composting experiments were conducted at the Oklahoma Equine Center located on the Oklahoma State University Stillwater campus.

An initial study to determine waste production and volume reduction characteristics was conducted in 1995-1996. Results of this study were presented at the international meeting of ASAE in Phoenix, Arizona on July 15, 1996, and at the Fifth Equine Nutrition and Physiology Symposium in Fort Worth, Texas on May 31, 1997. Papers presented at these meetings are given in Appendix G. From these presentations, Doug Hamilton was asked to participate as an expert on small composting systems in the Private Grazing Lands Workshop at Utah State University on July 8-11, 1997. A list of participants and a summary of the findings of the Ranchette Working group from this workshop are also given in Appendix G.

The initial experiment determined that on-site composting of stall cleanings was not only feasible but produced a high quality composted product. The greatest drawback to the system was the amount of labor required to mix compost. A second study was initiated in the summer of 1997 using an intern from the NSF-OKAMP program, a minority assistance scholarship program. The student in this study examined volume changes in mixed and unmixed bins during the hot phase of composting. The continuous bin composting system was developed from the data collected in these studies. Theory and use of the continuous bin composters is outlined in Factsheet F1729 - *Composting System for Small Horse Farms* (Appendix D). Use of continuous composting bins was demonstrated at two locations.

Northeast District: Horse Manure Composting

Adams Horse Farm

Win Adams, an Extension Applications Engineer for OSU Extension, and his wife Patty raise horses, dogs and exotic livestock on their seven-acre farm north of Claremore in Rogers Co. Ms. Adams expressed interest in demonstrating the continuous bin composting system. The Small Farms Project provided T-posts and fencing to construct two, 18' x 6' wide compost bins to be used as described in factsheet F1729 - *Composting System for Small Horse Farms*. The bins were built during the summer of 1999. Total materials cost was $105. The Adams' were also given a probe thermometer to monitor composting performance. Use of the bins was intermittent until the spring of 2000. Compost samples have been taken twice for analysis. By May of 2000, Ms. Adams had removed about 45 cubic feet of finished compost from the pile and was delighted with the results. Her only complaint was the strength needed to pitch the mixed compost and new cleanings back on top of the pile each time new material was added. The system is currently in use and more samples will be taken. The Rogers Co. 4-H Educator, who works in the same office as Mr. Adams, has expressed interest in introducing the compost system to her horse club. A photograph of the system in use is given in Appendix G.

Southwest District: Horse Manure Composting

Jeffcoat Horse Farm

Mike Jeffcoat owns a small stable located near Ringling, Oklahoma. Three to five horses are housed in stalls at all times. Project funds were used to purchase panels and posts to set up a continuous composting bin. He was also given a thermometer to measure temperature. In a departure from the system described in Factsheet F1729 - *Composting System for Small Horse Farms*, Jeffcoat used mechanical equipment to remove stall waste and stack compost. After the first six months of operating, he removed the T-posts and panels to make it easier to maintain the compost system using a tractor and front-end loader. Jeffcoat has been using the compost system continuously for two years and is very pleased with the results. He usually has all of his compost "spoken for" before it is time to remove material from the back of the pile. A photograph of the system in use is given in Appendix G.

Task 4: Reporting

This report, in combination with previously submitted quarterly and semi-annual reports, completes the reporting task.

Task 5: Measures of Success

In-Service Training of Agency Personnel

As reported in the Task 1: Assessment section of this report, two in-service training sessions were held for agency personnel. The training sessions were attended by roughly equal numbers of extension and conservation district personnel. Pre- and post-tests were given to measure success of delivery. Although questions on the pre- and post-tests were not identical, they were devised to assess audience knowledge levels in

three categories: animal waste management systems, manure nutrient utilization, and pollution prevention. Results of the tests are given in Tables C-1 and C-2, Appendix C.

Animal Waste Management Systems

Animal waste management systems can be described as a series of storage and treatment components connected by a transport component. This systematic approach is summed up in OSU Extension Factsheet F-1734 - *What is a Waste Management System?* (Appendix D), completed using 319 funds for the Swine Waste Management Education project (CWQ Sect 319(h) FY1997 NPS Task 220, OCC Task 100). Audience understanding of waste management systems was gauged by how well they understood operation of the storage component of a typical dairy waste management system (Question 5 Post-test, Appendix C). Ninety-seven percent of the agency personnel in Pryor (Table C-1) and 92% of the agency personnel in Chickasha (Table C-2) understood management of storage ponds well enough to know that the pond would overflow if the runoff entered the pond causing liquid level to exceed stormwater freeboard.

Manure Nutrient Utilization

A problem with using animal waste as fertilizer is, in most cases, phosphorus contained in manure is out of balance with nitrogen. Crops require more nitrogen for growth than phosphorus. Furthermore, very little of the phosphorus consumed by grazing cattle is removed from pasture. Most of the phosphorus contained in plants removed from the site is returned to the soil through feces and urine deposited by the grazing animal.

Many of the agency personnel knew of the problem of manure phosphorus imbalance prior to the in-service. Eighty-five percent of the audience in Pryor answered question 4 on the pre-test correctly (Table C-1). Seventy-one percent of the Chickasha audience was aware of the imbalance (Table C-2). Awareness of the imbalance increased through information received at these training sessions. One hundred percent of the Pryor audience and 87% of the Chickasha audience correctly answered question 2 on the post-test.

On the other hand, both audiences poorly understood recycling of pasture phosphorus prior to the in-service. Only 10% of the Pryor audience and 8% of the Chickasha audience correctly answered question 2 on the pre-test. Comprehension of phosphorus use in pasture greatly improved with northeast Oklahoma agency personnel as a result of this in-service. Eighty percent of the Pryor audience answered question 1 correctly on the post-test. Knowledge did not increase substantially with the Chickasha audience. Only 17% answered question 1 correctly on the post-test.

Pollution Prevention Techniques

Only 20% of the audience at either location could identify any of the pollution prevention terms given in the introduction of this report prior to the in-service training (Table C-1, Table C-2, Appendix C). Afterwards, the Pryor audience could correctly identify use of pollution prevention techniques 77% of the time (composite of answers to question 6 post test). Understanding use of pollution prevention techniques rose to 69% after the Chickasha in-service.

Attendance at Meetings, Field-days, Tours

Attendance from the pollution prevention workshops for producers is a good gauge of project success. Forty-two percent of all licensed poultry operators in Adair, Cherokee, and Delaware Counties attended the pollution prevention workshops. Approximately 12% of grade A dairies in Adair, Cherokee and Delaware Counties were represented at the meetings. Likewise, 8% of Mayes and Rogers County Dairies, and 20% of Grady County dairies were represented.

Improvement of Producers Knowledge

Poultry Producers

Poultry producers' knowledge of various pollution prevention technologies before and after implementation of the project is given in Tables H-1 and H-2. A decrease in "no response" and "never heard of" responses indicates that overall, knowledge increased in every category. The knowledge increase can be attributed to the information given through the project, as well as OSU's poultry operator training program.

Dairy Producers

Knowledge and use of waste management technologies in the six targeted counties are given in Tables H-3 and H-4. Overall knowledge increased as indicated by a decrease in "no response" and "never heard of" responses.

Increased Implementation of BMPs

Use of BMPs before and after the project as gauged by surveys is given in Tables H-1 through H-6, Appendix H.

Poultry Producers

The percentage of poultry producers using or considering using litter storage increased from 13% to 43% between 1997 and 2000. This increase will have a direct impact on water quality as farmers begin to store litter for better nutrient distribution to the land. As shown in the audience profile section, only 15% of Adair, Cherokee, and Delaware County poultry producers own or control sufficient acreage to distribute nutrients within the limitations of an AWMP. Use of storage facilitates movement of nutrients off the farm and promotes better application timing. The number of producers constructing litter storage may increase as their financial situation improves (27% considered using structures in 2000; whereas only 16% actually used structures).

The number of producers interested in composting and feeding litter to cattle declined slightly between 1997 and 2000. The decline may be due to the fact that more producers have had negative experience with these techniques in the three years between surveys.

Use of soil testing, manure testing, and record keeping increased dramatically with poultry producers in the targeted counties as shown in Tables H-5 and H-6. Nearly all poultry producers surveyed in 2000 are now using soil and litter testing (the 5% who reported not testing soil did not report any pasture or crop acreage). The increased use of pollution prevention tools is partially due to the fact that the Oklahoma Licensed Poultry Operators Act of 1998 requires soil and litter testing, as well as records of farm litter production. However, the law does not require balancing nutrients produced to

nutrients used through yield goals and individual field records. The increased use of these techniques is a direct result of our efforts in the targeted counties.

Dairy Producers
The increase in reported use of lagoons and waste storage ponds as shown in Table H-4 may be due to producers realizing what type of storage system they have through knowledge gained by project efforts. The number of producers claiming to use solid-liquid separation in the 2000 survey is misleading. This question was trying to determine the number of dairy producers using settling basins or mechanical solid separators, but it is doubtful that 36% of Oklahoma dairymen are now using these devices. It is more likely that producers interpreted "solid-liquid separation" as referring to handling manure (solid) and milk (liquid) center wastewater as two separate waste streams; a technique they learned in the Spring 2000 training sessions.

From Table H-5, it appears dairy producers are using soil testing and yield goals at about the same rate as poultry producers. Dairy farmers use manure testing and records much less than poultry producers, however. To be fair, Oklahoma dairy producers appear to be adopting pollution prevention at a rate greater than their peers across North America. The results of a survey of environmental practices by dairy farmers conducted by *Dairy Herd Management* magazine are given in Table H-8. Oklahoma dairymen use soil testing more frequently and manure testing in about the same percentage as dairymen across the U.S. and Canada. The *Dairy Herd Management* survey did not ask about record keeping. Oklahoma farmers are more likely to use a lagoon. This may stem from two factors. First, many Oklahoma dairies house cattle on pasture and use a lagoon to treat milk center wastewater; second, lagoons work best in warmer climates. Many of the producers surveyed in Table H-8 come from areas to the north of Oklahoma.

Implementation of BMPs: Notebooks

Poultry Producers
Twenty-nine percent of all poultry operators who completed the initial education requirements of the Oklahoma Licensed Poultry Operator training asked to receive a poultry recordbook developed through this project. Request rate in the targeted poultry area was slightly higher at 39%. One hundred fifty-two (42%) of the licensed operators in the targeted area received special training to use the notebooks. In the survey conducted through this project (Table H-6), 88% of the poultry producers in the targeted area indicated that they used application records in 2000. This is up from 34% who used records in 1997. More specific to this project, 68% of Adair, Cherokee, and Delaware County poultry producers used individual field application records in 2000, as opposed to a mere 5% in 1997. Field application records are not required by the Oklahoma Lisenced Poultry Operator Act. The increased use of field records by poultry producers is an indication of the success of this project.

Dairy Producers
According to pre- and post- implementation survey results, use of application records by dairy producers in the targeted areas did not change during the project time period and actually declined in Mayes and Rogers Counties (Table H-6). Use of manure testing and record keeping by dairy farmers with liquid or slurry handling systems is given in

Table H-7. Only 6% of surveyed dairymen used the full complement of tests and records required if the farm had a CAFO permit. Anecdotal evidence suggests that dairy farmers do not see the value of pollution prevention based on the economic benefits of nutrient recycling alone. The cost and effort required to accurately account for manure nutrients is not perceived to be in line with what dairy farmers consider a low-value commodity. This information will be used to change educational goals by demonstrating the impact of pollution prevention on improving overall soil quality, water use, and labor requirements.

Conclusions

This project was a five-year experience in developing pollution prevention plans for small farmers. The first lesson learned was to limit the scope of the project to a number of priorities based on the needs of the audience. Secondly, in a voluntary environmental program, it is extremely important to tailor the educational product so that the producer not only protects the environment, but also is able to see an increase in productivity or profitability.

Pollution prevention record keeping systems were developed for poultry and dairy producers. The development process was iterative starting with the records developed for swine producers. By working with demonstration farms, the swine-based recordbooks were altered to be more useful for dairy and poultry farms. Record systems found acceptance by a high percentage of poultry producers. This was partially due to the fact that record keeping became involuntary at passage of the Oklahoma Licensed Poultry Operations Act, but producers had a choice to use any record keeping system available. Thirty-nine percent of the operators in the targeted area opted to use the record system and factsheets developed in the project. Eighty-eight percent of operators in the targeted area use some form of the records developed in this project. Dairy farmers were less amenable to begin using voluntary pollution prevention records. However, a record system has been developed for their use. The developed system will continue to be improved, in order to better use pollution prevention records. Both of the developed systems, for poultry and for dairy, are adaptable to records that will be required by the proposed revisions to NPDES Permit Regulations and Effluent Guideline Standards for CAFOs.

Use of nutrient management tools such as soil and manure sampling increased dramatically with poultry producers in the targeted area. Again, dairy farmers were less likely to use all tools available to them, but a 20% increase in soil sampling by dairy farmers in the targeted areas was observed through pre- and post-project surveys. Learning to convey pollution prevention techniques to small dairy farms resulted in the OCES working with Idle Knot Dairy in Payne County, Oklahoma, recipient of a Kerr Center for Sustainable Agriculture producer grant to make waste management improvements on their farm.

A low-cost, low-labor composting system was developed for horse owners with less than 10 animals housed in stalls. The system was demonstrated on two active horse farms. Both farms are producing high quality compost with very little increase in labor. The composting system has been made available to the scientific and extension

communities. OCES will continue to improve on the system and promote its adoption to preserve water quality.

In short, this project is a base upon which to build voluntary pollution prevention programs with smaller livestock operations. Information gained through this project can be used by OCES as well as other regulatory and educational agencies to better serve this oftentimes neglected audience.

Appendix A: Workplan

Agency: Oklahoma Conservation Commission
Title: Small Farm Livestock Pollution Prevention Program
Task: 500
Cooperating Agencies:
Oklahoma State Department of Agriculture (OSDA)
Oklahoma State University Cooperative Extension
Local Conservation District
Soil Conservation Service

Project Introduction

This project will educate small livestock producers about management and recycling of animal waste nutrients to prevent pollution. Considerable effort has been devoted to educating operators of large Concentrated Animal Feeding Operations, or CAFOS, since the promulgation of the EPA Region 6 permit for stormwater discharge from CAFOS. However, very little effort has been addressed to the numerous small operations that are prevalent throughout eastern central, and southwestern Oklahoma. The northeastern and southwestern parts of Oklahoma have a large number of small dairies and feedlots. Stocker-Feeder operations, which prepare finishing beef cattle by feeding on pastures and wheat fields, are concentrated in Central Oklahoma. Broiler operations, primarily located in Northeastern Oklahoma, may have large animal numbers, but due to dry in-house waste handling systems, they are not permitted as CAFOS. Horse farms, and pleasure horses housed on small lots, are scattered throughout the State of Oklahoma. Although horses are housed and grazed on very small, partially denuded areas, animal numbers are usually too small for the farms to be permitted as CAFOS. Considered together, the small dairies, stocker feeder operations, broiler operations, and horse farms account for a large portion of the state's non-point source pollution from animal agriculture. Currently, these small farms receive little attention and virtually no educational services related to pollution control.

Non-regulatory options are very effective in controlling pollution from small animal farms. These options include soil testing, manure testing, forage testing, nutrient management planning, and record keeping. The Cooperative Extension Service (CES) and the Natural Resources Conservation Service (NRCS) has programs to educate small farmers about non-regulatory controls. These programs need to be coordinated and targeted to address the specific problems of pollution control. This project will use record keeping as an overarching BMP to control pollution. A core group of small farmers will be taught to use pollution prevention handbooks in a series of workshops. A number of demonstration farms will show the positive effects of non-regulatory pollution control measures.

This project will focus on the small, CAFO exempt, livestock operations in two areas: small dairies, broilers, and horses in Northeastern Oklahoma; stocker-feeders, small dairies and ' horses in Southwestern Oklahoma. The northeastern target area falls predominantly in the Grand Lake and Illinois River drainage areas. The southwestern target area is largely in the Little Washita drainage area. It is necessary to target two areas because of the diversity of Oklahoma agriculture and climate. For instance, broiler production is confined to the easternmost counties of Oklahoma. Stocker-Feeder operations are located mainly in western Oklahoma. Climatic conditions vary dramatically as you travel westward in Oklahoma. Waste management systems adapted to the northeastern part of the state bear little resemblance to those used in the southwest.

The project will be implemented primarily by the CES. A faculty member will administer and oversee the project part-time. Two area water quality specialists will work part-time to

coordinate and implement the project in the field. A full-time student worker will be hired to help write the pollution prevention handbooks. Additional project support will come from OCC, OSDA, NRCS and local Conservation Districts.

Project Maps:

Watershed maps of Basin 1, showing the northeastern target area, Basin 3, showing the southwest target area, are attached.

Project Objectives

To educate producers of small livestock farms about pollution control practices, teaching them to implement the practices by keeping records for planning and documentation of waste and nutrient management.

Project applicability

Although not specifically mentioned in the 319 assessment and 303 (D) list, agricultural source codes and related cause codes frequently cited in those documents should be considered suggestive of animal waste in runoff from small farm sources.

Project duration:

Three years.

Project Tasks

1. Assess small livestock producers' knowledge of pollution prevention measures before implementation of project. Determine improvement in knowledge base and adoption of practices following project
2. Implement pollution prevention practices on small farms in northeastern and southwestern Oklahoma. BMPs will be integrated by use of small farm pollution prevention handbooks.
3. Set up demonstration farms using existing or new waste handling facilities. Demonstrations will show how BMPs--record keeping, soil testing, manure testing, nutrient management, grazing management, etc.--can prevent pollution on small farms.
4. Write quarterly and final reports to document number of landowners participating, results of demonstration farms, and findings of pare and post implementation surveys, and other measures of progress.

Project Milestones

1. Contact producers and identify demonstration farms	July 95-Mar 96
2. Contact commodity groups and publicize project	Nov 95-Mar 96
3. Conduct in-service training for a2encv personnel	Nov. 95-Mar 96
4. Complete pre-implementation survey	Mar 96
5. Set up demonstration farms	Mar 96-Aug 99
6. Hold public meetings to publicize project and familiarize small livestock farmers with pollution prevention concepts	Bi-annually, Beginning Mar 96
7. Complete draft pollution prevention handbooks	May 96
8. Conduct workshops with small groups of farmers to teach use of pollution prevention handbooks	July 96-Nov 99
9. Conduct field days and tours on demonstration farms, seasonally	Beginning July 96
10. Complete post-implementation survey	Dec. 99
11. Prepare quarterly reports	Quarterly
12. Prepare final report	July 2000

Project Outputs

500.1 Quarterly reports beginning October 1, 1995. Semiannual after October 1, 1997

500.2 Assessment of small livestock producers knowledge of pollution prevention methods prior to project. Pre-implementation survey. Due March 30, 1996

500.3 Assessment of projects effectiveness in increasing producers knowledge of pollution prevention methods. Post-implementation survey. Due December 30, 1997

500.4 Small farm pollution handbooks for diary, r, broiler and operations. Due Nov 1999 (See Semi-annual report April 15, 1998)

500.5 Twenty five small producers trained to use pollution prevention hand books

500.6 Four cooperators in northeastern Oklahoma demonstrating pollution prevention and nutrient management practices on dairy, broiler and horse farms.

500.7 Four cooperators in southwestern Oklahoma demonstrating pollution prevention and nutrient management practices on dairy, stocker and horse farms.

500.8 Final Progress Report. Due July 2000

500.9 Develop a simplified composting system for horse producers.

500.10 Fact sheets as needed for dairy, stocker, broiler, and horse operations, which will supplement the pollution handbooks.

Measures of Success

1. Number of field personnel completing in-service training and their success in passing the post-training evaluation test.
2. Number of animal producers attending public meetings, workshops, field days, and tours
3. Improvement in producers' knowledge of pollution control indicated by pre and post implementation surveys.
4. Implementation of BMPs by small livestock producers indicated by use of pollution prevention hand books.

Cost Breakdown

Task 1.	Pre and Post Implementation Surveys	$27,000
Task 2.	Implementation of BMPs through Hand Books and fact sheets.	$106,000
Task 3.	Demonstration of BMPs by Cooperators	$125,000
Task 4.	Reports	$16,262
	TOTAL	$274,262

Project Budget

Federal	$164,557
State	$109,705
Total	$274,262

Appendix B: Pre-and Post-implementation Audience Profiles

Table B-1. Profile of all respondents to pre- and post-implementation surveys.

	1997 Responses ***(n)***	**2000 Responses** ***(n)***
Animals Identified as the Primary Operation		
Beef (cow/calf)	158	4
Beef (stocker/feedlot)	33	0
Dairy	61	22
Broilers	17	30
Laying Hens	5	23
Turkey	0	6
Swine	6	0
Horses	2	0
Sheep and Goats	3	0
Rabbits	0	0
Other	12	7*
County		
Adair	57	24
Blaine	3	0
Caddo	30	0
Canadian	1	0
Cherokee	3	7
Cleveland	34	0
Comanche	3	0
Craig	2	0
Custer	1	0
Delaware	46	43
Grady	45	4
Kiowa	1	0
Latimer	1	0
Mayes	24	12
McClain	33	0
Murray	1	0
Ottawa	2	0
Pittsburgh	1	0
Pottawatomie	1	0
Rogers	3	2
No response	5	0
Total Number Responding	**297**	**92**

*1 dairy replacement heifers and 6 poultry breeding farms.

Table B-2. Profile of poultry producers in Adair, Delaware, and Cherokee Counties.

	1997 Responses		2000 Responses	
	(n)	*(%)*	*(n)*	*(%)*
Type of Primary Poultry Operation				
Broilers	29	76	30	44
Laying Hens	8	21	24	35
Turkey	1	3	6	9
Breeders and Others	0	0	8	12
Education Level				
No answer	4	11	4	6
Grade School	0	0	2	3
High School	17	45	41	60
Vo-Tech	4	11	4	6
Some College	7	18	10	15
College Graduate	6	16	7	10
Farms w/ other Animal Enterprises	**32**	**84**	**40**	**59**
Type of Secondary Animal Enterprise				
Beef (cow-calf)	22	58	34	50
Beef (stocker-feedlot)	0	0	1	2
Dairy	6	16	1	2
Swine	5	13	1	2
Horses	4	11	4	6
Goats	3	8	0	0
Acreage of Pasture				
No answer	3	8	14	21
0 to 40	8	21	12	18
41 to 80	4	11	15	22
81 to 160	11	29	14	21
161 to 320	10	26	11	16
>320	2	5	2	3
Total Number Responding	**38**		**68**	

Table B-3. Percentage of Adair, Delaware, and Cherokee County broiler producers reporting sufficient land to spread litter in an animal waste management plan.

Application Rate	1997 (n=20)	2000 (n=20)
200 lbs P_20_5 per Acre-year	33%	15%
40 lbs P_2O_5 per Acre-year	0%	5%

Table B-4. Profile of dairy producers in Adair, Delaware, Cherokee. Mayes, Rogers, and Grady Counties.

	1997 Responses		2000 Responses	
	(n)	***(%)***	***(n)***	***(%)***
Education Level				
No answer	1	2	1	5
Grade School	6	10	0	0
High School	33	54	13	59
Vo-Tech	1	2	1	5
Some College	12	20	4	18
College Graduate	8	13	3	13
Farms w/ other Animal Enterprises		**59**		**71**
Type of Secondary Animal Enterprise				
Beef (cow-calf)	21	34	18	82
Beef (stocker-feedlot)	9	15	1	5
Broilers	6	10	3	14
Horses	10	16	4	18
Swine	4	7	1	5
Laying Hens	5	8	0	0
Number of Cows				
No answer	6	10	1	5
0 to 50	13	21	7	32
51 to 100	20	33	8	36
100 to 200	17	28	4	18
>200	5	8	2	9
Combined Pasture and Crop Acreage				
No answer	5	8	1	5
0 to 80	4	7	1	5
81 to 160	13	21	4	18
161 to 320	13	21	6	27
321 to 640	16	26	6	27
>640	10	16	4	18
Total Number Responding	**61**		**22**	

Table B-5. Profile of dairy producers in Mayes and Rogers Counties.

	1997 Responses		2000 Responses	
	(n)	***(%)***	***(n)***	***(%)***
Education Level				
No answer	0	0	2	15
Grade School	5	19	0	0
High School	10	39	7	54
Vo-Tech	1	4	1	8
Some College	7	27	2	15
College Graduate	3	12	1	8
Farms w/ other Animal Enterprises		**77**		**69**
Type of Secondary Animal Enterprise				
Beef (cow-calf)	17	65	9	69
Beef (stocker-feedlot)	4	15	0	0
Broilers	0	0	1	8
Horses	6	23	3	23
Swine	1	4	1	8
Laying Hens	4	15	0	0
Number of Cows				
No answer	1	4	1	8
0 to 50	9	35	6	46
51 to 100	9	35	4	31
100 to 200	7	27	1	8
>200	0	0	1	8
Combined Pasture and Crop Acreage				
No answer	2	8	0	0
0 to 80	1	4	1	8
81 to 160	1	4	1	8
161 to 320	8	31	4	31
321 to 640	8	31	5	39
>640	6	23	2	15
Total Number Responding	**26**		**13**	

Table B-6. Pre-implementation (1997) survey responses from Adair, Delaware, Cherokee, Mayes, Rogers, and Grady County dairies sorted by size of milking herd.

	Size of milking herd			
	1 - 50 ***(n=18)***	**51 - 100** ***(n=20)***	**101 - 200** ***(n=17)***	**200+** ***(n=5)***
Education Level				
No answer	1	0	0	0
Grade School	4	0	1	0
High School	9	15	6	3
Vo-Tech	0	0	1	0
Some College	2	2	8	0
College Graduate	2	3	1	2
Age				
<30	1	0	0	0
31 to 60	15	17	13	4
>60	2	3	4	1
Farms w/ other Animal Enterprises	**11**	**18**	**6**	**1**
Type of Secondary Animal Enterprise				
Beef (cow-calf)	6	12	2	0
Beef (stocker-feedlot)	3	4	2	1
Laying Hens	2	2	0	0
Broilers	1	2	1	0
Horses	1	3	3	0
Swine	2	2	0	0
Acreage of Cropland				
No answer	1	5	0	0
0	9	6	10	2
1 to 80	0	4	1	0
81 to 160	2	1	2	0
161 to 320	6	4	3	1
321 to 640	0	0	1	1
>640	0	0	0	1
Acres of Pasture				
No answer	1	5	0	0
0	0	0	0	0
0 to 80	2	1	2	0
81 to 160	6	7	4	1
161 to 320	6	4	3	1
321 to 640	3	3	6	2
>640	0	0	2	1

Table B-7. Post-implementation (2000) survey responses from Adair, Delaware, Cherokee, Mayes, Rogers, and Grady County dairies sorted by size of milking herd.

	Size of milking herd			
	1 - 50 ***(n=7)***	**51 - 100** ***(n=8)***	**101 - 200** ***(n=4)***	**200+** ***(n=2)***
Education Level				
No answer	0	2	0	0
Grade School	0	0	0	0
High School	6	4	2	0
Vo-Tech	1	0	0	0
Some College	0	1	1	1
College Graduate	0	1	1	1
Age				
<30	0	0	0	0
31 to 60	4	5	4	2
>60	3	3	0	0
Farms w/ other Animal Enterprises	**5**	**6**	**2**	**2**
Type of Secondary Animal Enterprise				
Beef (cow-calf)	5	6	2	2
Beef (stocker-feedlot)	0	0	1	0
Laying Hens	0	0	0	0
Broilers	1	2	0	0
Horses	0	3	0	0
Swine	1	0	0	0
Acreage of Cropland				
No answer	0	0	1	0
0	3	5	0	0
1 to 80	2	0	0	0
81 to 160	1	1	0	0
161 to 320	1	2	2	1
321 to 640	0	0	1	0
>640	0	0	0	1
Acres of Pasture				
No answer	0	0	1	0
0	0	0	1	0
0 to 80	2	0	0	0
81 to 160	1	4	0	0
161 to 320	2	4	1	0
321 to 640	1	0	1	0
>640	1	0	0	2

Table B-8. Percentage of Adair, Delaware, Cherokee, Mayes, Rogers, and Grady County dairy producers reporting crop and pasture acreage in 1997 survey with sufficient land to recycle all excreted manure on the home farm.

	Size of Milking Herd				
	<50 ***(n=11)***	**51 - 100** ***(n=12)***	**101 - 200** ***(n=16)***	**>200** ***(n=5)***	**All** ***(n=44)***
Allowable: Cropland: 400 lbs P_2O_5/acre-yr Pasture: 200 lbs P_2O_5/acre-yr	100%	100%	100%	100%	100%
Crop Uptake: Cropland: 50 lbs P_2O_5/acre-yr Pasture: 40 lbs P_2O_5/acre-yr	91%	83%	63%	60%	75%

Table B-9. Percentage of Adair, Delaware, Cherokee, Mayes, Rogers, and Grady County dairy producers reporting crop and pasture acreage in 2000 survey with sufficient land to recycle all excreted manure on the home farm.

	Size of Milking Herd				
	<50 ***(n=6)***	**51 - 100** ***(n=6)***	**101 - 200** ***(n=3)***	**>200** ***(n=2)***	**All** ***(n=13)***
Allowable: Cropland: 400 lbs P_2O_5/acre-yr Pasture: 200 lbs P_2O_5/acre-yr	100%	100%	100%	100%	100%
Crop Uptake: Cropland: 50 lbs P_2O_5/acre-yr Pasture: 40 lbs P_2O_5/acre-yr	66%	100%	100%	50%	75%

Table B-10. Profile of all beef producers answering the 1997 survey.

	(n)	*(%)*
Education Level		
No answer	6	3
Grade School	6	3
High School	74	32
Vo-Tech	5	2
Some College	45	20
College Graduate	93	40
Age		
No answer	7	3
<30	7	3
31 to 60	133	58
>60	82	36
Type of Operation		
Cow-calf only	128	56
Cow-calf and stocker	24	10
Cow-calf and poultry	22	10
Cow-calf and dairy	18	8
Stocker only	12	5
Stocker and dairy	7	3
Feedlot	6	3
Other cow-calf combination	12	5
Able to Distribute Manure over Reported Acreage (n=132)*		
Allowable		
Cropland: 400 lbs P_2O_5/acre-yr	131	99
Pasture: 200 lbs P_2O_5/acre-yr		
Crop Uptake		
Cropland: 50 lbs P_2O_5/acre-yr	101	77
Pasture: 40 lbs P_2O_5/acre-yr		
Total Number Responding	**229**	

*Beef producers who reported both cattle numbers and acreage and could not be identified as either a poultry or dairy producer.

Table B-11. Profile of all horse owners answering the 1997 survey

	(n)	***(%)***
Education Level		
No answer	0	0
Grade School	5	9
High School	10	18
Vo-Tech	3	5
Some College	12	22
College Graduate	25	46
Age		
No answer	0	0
<30	1	2
31 to 60	37	67
>60	17	31
Horse as Primary Enterprise	**3**	**6**
Number of Horses Owned		
No answer	4	7
1 to 5	43	78
6 to 10	5	9
11 to 20	3	6
>20	0	0
Total Number Responding	**55**	

Appendix C: In-Service Meetings

Expected Production Worksheet

Manure and Soil Analysis Records

Core Records

Table C-1. Results of Northeast District In-Service -- Pryor, November 15, 1995

Concept	Pre-Test				Post-Test			
	Q	% Correct	% Incorrect	% No Answer	Q	% Correct	% Incorrect	% No Answer
Waste Treatment System								
Components	Q1	63	-	-	Q5	97	0	3
Storage	b,d	68	30	2				
Transport	c,g	75	22	3				
Treatment	e	45	50	5				
Utilization	h	80	15	5				
Lagoon Vs Storage	Q5	50	50	0				
	Q6	60	30	10				
Nutrient Utilization								
Grazing	Q2	10	90	0	Q1	80	20	0
Feel for Nutrients	Q3	30	65	5	Q3	60	40	0
P relative to N	Q4	85	15	0	Q2	100	0	0
Economic Return					Q4	67	33	0
Pollution Prevention Terms								
Source Reduction	Q7	20	-	-	Q6	77	-	-
Recycling					a,b	67	30	3
Treatment					d,e	83	19	3
Disposal					c,f	74	34	2
					g	93	7	0

Table C-2. Results of Southwest District In-Service -- Chickasha, March 28, 1996

Concept	Pre-Test				Post-Test			
	Q	% Correct	% Incorrect	% No Answer	Q	% Correct	% Incorrect	% No Answer
Waste Treatment System								
Components	Q1	68	-	-	Q5	92	4	4
Storage	b,d	84	-	3				
Transport	c,g	67	13	2				
Treatment	e	75	31	4				
Utilization	h	83	21	4				
Lagoon Vs Storage	Q5	50	50	0				
	Q6	54	46	0				
Nutrient Utilization								
Grazing	Q2	8	88	4	Q1	17	83	0
Feel for Nutrients	Q3	42	50	8	Q3	35	65	0
P relative to N	Q4	71	29	0	Q2	87	13	0
Economic Return					Q4	61	39	0
Pollution Prevention Terms								
Source Reduction	Q7	20	-	-	Q6	69	-	-
Recycling					a,b	61	39	0
Treatment					d,e	77	23	0
Disposal					c,f	59	61	0
					g	91	0	9

Table C-3. In-service training opportunities related to the small farms livestock pollution prevention project.

Date	Location	Meeting	Audience	Content
April 4, 1995	Chickasha, OK	Grady County Dairy Pumpers	Extension Educators, Conservation District Personnel, Dairy and Feedlot Producers	Expected Nutrient Content of Dairy manure, calibration of pumping equipment.
April 12, 1995	Cordell, OK	SW District Scheduled In-service	County and Area Extension Educators	Animal Waste Systems, Animal Waste Management Plans
Aug. 5, 1995	Oklahoma City, OK	ODA Inspector Training	State CAFO Inspectors	Animal Waste Systems
Sept. 7,1995	Stillwater, OK	Oklahoma Animal Waste Forum	University, Government Livestock Company personnel	Gathering input on OSU animal waste program
Nov. 15-16, 1995	Pryor, OK	NE District SFLPP In-service	Extension Educators, Conservation District Personnel	In-service training for this project
Dec. 7-8, 1995	Oklahoma City, OK	Sustainable Agriculture Training	Extension Educators	Mass balance of pollutants in sustainable animal waste systems
March 28, 1996	Chickasha, OK	SW District SFLPP In-service	Extension Educators, Conservation District Personnel	In-service training for this project
April 24, 1996	Oklahoma City, OK	Oklahoma Governor's Conference on the Environment	Government Agency personnel, Env. and Commodity Groups, News Media	Mass balance of pollutants in sustainable animal waste systems
July 23, 1996	Jay, OK	OCES-NRCS Joint training for Poultry Industry	Poultry Company Service Personnel	Manure handling systems, animal waste management plans, records
Aug 29, 1996	Stillwater, OK	NRCS Resource Engineers Training	NRCS Resource Engineers	Pollution Prevention Techniques, SFLPP goals

Table C-3. In-service training opportunities related to the small farms livestock pollution prevention project.

Date	Location	Meeting	Audience	Content
Oct 22, 1996	Stillwater, OK	WQ In-service Training	State and area extension educators	Results of pre and post testing from project in-service training
May 2, 1997	Oklahoma City, OK	EPA Region 6 NPDES Inspectors training	State and Federal Permit Inspectors	Manure handling systems, animal waste management plans, records
April 17, 1998	Stillwater, OK	Oklahoma Association of Farm and Land Appraisers	Licensed Ag Appraisers	Animal Waste Systems, Animal Waste Management Plans, OSU programs and SFLPP
May 18, 1998	Stillwater, OK	USDA Regional Extension Animal Science Specialists Meeting	State Extension Educators	Animal Waste Systems and new technologies to help with pollution prevention
June 2-3, 1998	Chickasha, OK	Sustainable Agriculture Training	Extension, NRCS, State Agency and Tribal personnel	Pollution Prevention Techniques and results from Brown Dairy.

Appendix D: Factsheets

Appendix E: Record Keeping Notebooks

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Appendix F: Pollution Prevention Workshops

Table F-1. Poultry Producer Meetings and Notebook Distribution

County	Licensed Operators In County	Pollution Prevention Notebooks distributed In County	Meeting Site	Meeting Date	Operators attending meeting
Adair	110	37	Stilwell	11-09-1999	65
Cherokee	38	24	Tahlequah	12-15-1999	45
Delaware	213	81	Jay	10-26-1999	42

Table F-2. Dairy Farms Receiving Pollution Prevention Notebooks

Farm Name	**County Located**	**Meeting Site**	**Meeting Date**	**Notebook #**
AJ Dairy	Cherokee	Stilwell	2-16-2000	29
Kelley	Cherokee			6
K. Wick	Adair	Stilwell	2-16-2000	23
S. Wick	Adair	Stilwell	2-16-2000	22
Stogsdill	Adair	Stilwell	2-16-2000	19
Woods	Adair	Stilwell	2-16-2000	28
J. Grooms	Adair	Stilwell	2-16-2000	24
B. Grooms	Adair	Stilwell	2-16-2000	27
Yell	Adair	Stilwell	2-16-2000	26
Stice	Adair	Stilwell	2-16-2000	20
Sisson	Delaware	Pryor	2-17-2000	32
Phillips	Delaware	Pryor	2-17-2000	42
Chanley	Delaware			11
Ford	Mayes	Pryor	2-17-2000	31
Yoder	Mayes	Pryor	2-17-2000	40
Coblentz	Mayes	Pryor	2-17-2000	42
Stutzman	Mayes	Pryor	2-17-2000	5
Brown	Grady	Chickasha	2-23-2000	1
McComas	Grady			2
B. Morris	Grady	Chickasha	2-23-2000	18
E. Morris	Grady	Chickasha	2-23-2000	34
Corley	Grady	Chickasha	2-23-2000	38
Griffith	McClain	Chickasha	2-23-2000	36

Appendix G: Horse Manure Composting System

Figure G-1. Continuous Bin Composting System on Adams Horse Farm

Figure G-1. Continuous Bin Composting System on Jeffcoat Horse Farm

Appendix H: Pre-and Post-implementation Survey Analysis

Table H-1. Pre-implementation (1997) survey results indicating the percentage of Adair, Cherokee, and Delaware County poultry producers with various levels of knowledge and use of three waste management technologies.

	Technology		
Knowledge/Use Level	**Litter Storage**	**Composting**	**Refeeding**
Used	11%	55%	8%
Considered using	2%	15%	8%
Heard of	42%	21%	29%
Never heard of	8%	3%	11%
No response	37%	16%	45%

Table H-2. Post-implementation (2000) survey results indicating the percentage of Adair, Cherokee, and Delaware County poultry producers with various levels of knowledge and use of three waste management technologies.

	Technology		
Knowledge/Use Level	**Litter Storage**	**Composting**	**Refeeding**
Used	16%	40%	4%
Considered using	27%	10%	4%
Heard of	41%	43%	40%
Never heard of	2%	2%	6%
No response	15%	6%	27%

Table H-3. Pre-implementation (1997) survey results indicating the percentage of dairy farmers with various levels of knowledge and use of three waste management technologies.

	Technology		
Knowledge/Use Level	**Lagoon**	**Waste Storage Pond**	**Solid-Liquid Separation**
Used	44%	13%	18%
Considered using	10%	10%	3%
Heard of	15%	23%	34%
Never heard of	3%	5%	2%
No response	55%	49%	43%

Table H-4. Post-implementation (2000) survey results indicating the percentage of dairy farmers with various levels of knowledge and use of three waste management technologies.

	Technology		
Knowledge/Use Level	**Lagoon**	**Waste Storage Pond**	**Solid-Liquid Separation**
Used	54%	32%	36%
Considered using	18%	10%	10%
Heard of	27%	46%	50%
Never heard of	0%	5%	0%
No response	0%	5%	5%

Table H-5. Producers using agronomic testing before and after implementation of the project.

Farm Type	Area	1997 Responses (n)	1997 % Using Crop Yield Goals	1997 % Using Soil Testing	1997 % Using Manure Testing	2000 Responses (n)	2000 % Using Crop Yield Goals	2000 % Using Soil Testing	2000 % Using Manure Testing
Poultry	Adair Delaware Cherokee	38	5%	37%	3%	68	24%	95%	98%
Dairy	Adair Delaware Cherokee Mayes Rogers Grady	61	26%	62%	16%	22	55%	82%	18%
Dairy	Mayes Rogers	26	34%	61%	0%	13	39%	85%	8%

Table H-6. Producers keeping records before and after implementation of the project.

Farm Type	Area	1997 Responses (n)	1997 % Using Application Records	1997 % Using Field Records	2000 Responses (n)	2000 % Using Application Records	2000 % Using Field Records
Poultry	Adair Delaware Cherokee	38	34%	5%	68	88%	68%
Dairy	Adair Delaware Cherokee Mayes Rogers Grady	61	18%	10%	22	18%	18%
Dairy	Mayes Rogers	26	23%	12%	13	8%	8%

Table H-7. Percentage of Adair, Delaware, Cherokee, Mayes, Rogers, and Grady County dairy farmers employing various pollution prevention techniques. (All respondents reported having used a lagoon or waste storage pond.)

Pollution Prevention Technique	**1997** ***(n=31)***	**2000** ***(n=16)***
Kept Rainfall Records	16%	6%
Kept Record of Lagoon or Pond Liquid Level	16%	6%
Used Manure or Effluent Testing	3%	19%
Kept Record of Manure or Effluent Applied	16%	19%
Used All Four Techniques Together	0%	6%

Table H-8. Results of a national survey of pollution prevention techniques used by dairy farmers (Quaife, 1999).

Pollution Prevention Technique Used or Considered	**1999** ***(n=637)***
Building a Lagoon	22%
Building a Manure Pit or Slurry Tank	38%
Using Soil Tests Before Spreading Manure	46%
Conducting Nutrient Test on Manure Stored in Lagoon	20%