AN EVALUATION OF MANAGEMENT PRACTICE USAGE AND WATER QUALITY EDUCATION IN SELECTED OKLAHOMA WATERSHEDS

By

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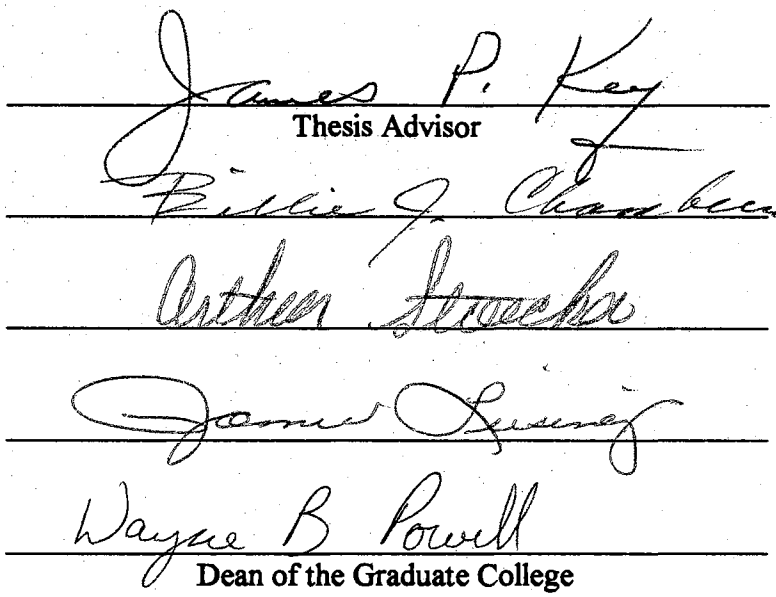

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CHAPTER I

INTRODUCTION

The following three papers which make up Chapters 2-4 all have a common theme and ideology behind them. All three chapters are concerned with what exactly agricultural producers are doing when it comes to water quality and, longitudinally, trying to determine if agricultural producers change over time when a water quality educational program is initiated in their area. The papers are also interested reporting research designed to determine if recent water quality educational programs are effective in what they seek to accomplish. It is a new strategy in Oklahoma -- this evaluation of water quality educational programming -- and there are certainly many human elements which come into play. These elements exist because, if there are water quality problems in an area, people are to blame, people are the key to education, and people are the means to a cure.

Water quality education is at best a difficult endeavor and almost always has political ramifications during all of its phases. So, why try to educate agricultural producers in new ideas and technologies that may protect their water quality if it is so hard to do? Some would say it is because of a desire to make the world a better place, or more simply, just make a small area of the world a better place. Others might argue that those who feel a need to environmentally educate people are only doing it for selfish ends and agendas and may care little for those they seek to educate. There is probably a little

truth in each of these philosophies, but what both of them seem to forget is that agricultural producers have needs of their own which will lead them to seek education that they feel is appropriate.

Agricultural producers seek education, but often times may not know exactly what that education may entail. It is up to educators to ensure that agricultural producers get the education they need. Educators may also provide new ideas related to the initial answers the producers sought.

In the following papers, a program that did not seem to work so well and a program that did seem to work well will be analyzed. The main noticeable differences between the two programs seemed to be four things: 1) the hiring of a County Extension Water Quality Agent in the successful program; 2) production differences between the two areas; 3) specific targeting of a small watershed in the successful program versus a more diffuse county wide approach in the unsuccessful program; and 4) animal waste disposal, as a result of poultry farms, was an identified problem in the successful program. It is very possible that the Extension Agriculture Agents are too busy to handle much new water quality programming and maintain their other programs. The trend does appear to be going toward increased water quality programming at the county level and even geographically smaller areas for modeling purposes; so, the hiring of Extension Agents for the specific purpose of conducting water quality agricultural education may be the answer for overworked Agriculture Agents and the water quality needs of the county. Also, more focused education that caters to the individual farm and management on that farm should be heavily considered.

CHAPTER II

DIFFUSION AND ADOPTION OF BEST MANAGEMENT PRACTICES AFFECTING WATER QUALITY IN SOUTHWEST OKLAHOMA

Report on the survey of residents of target watersheds in the study, "Educational Support to BMP Implementation in Southwestern Oklahoma," Task 1000 EPA 319-FY 1992

By Troy A. Pierce, James P. Key and Michael D. Smolen

INTRODUCTION

As part of the Oklahoma State University educational program, a telephone survey was undertaken to determine the attitudes, knowledge and behavior of residents of four targeted watersheds: Barnitz Creek, Lake Creek, Whiskey Creek and Willow Creek. At the start of the study, each of the target watersheds had received some attention from the lead nonpoint source agency, the Oklahoma Conservation Commission. This attention had come in the form of Environmental Protection Agency 319 (nonpoint-source-pollution) program cost sharing through the Conservation Districts of Lake Creek, Whiskey Creek and Willow Creek, and in the form of demonstration plots in the Barnitz Creek area.

The project was interested in determining residents' attitudes, knowledge and perceptions to help orient the project in a positive light, rather than attacking prevailing concerns head on. Many times agency assumptions about attitudes result in unnecessary

caution, and at other times there may be unanticipated reasons for caution. Either error can slow or cripple a project.

This survey attempted to assess respondents' attitudes, knowledge and perceptions about their water resource, about the quality and vulnerability of that water resource and their drinking water, and the sources that threaten their water resources. Behavior was assessed to determine the extent of Best Management Practice (BMP) implementation at the start of the project. The intention was to reassess at a later date to determine over time whether BMP implementation had changed, if residents' knowledge had changed, or if residents' attitudes had changed concerning water quality protection.

THEORETICAL/LITERATURE BASE

Rural America's water supply has been the focus of much attention and research in recent years. An excellent synthesis of the findings from research can be found in the Environmental Protection Agency seminar publication of the National Rural Clean Water Project Symposium, Ten Years of Controlling Agricultural Nonpoint Source Pollution: The RCWP Experience (1992). This publication documents the work of the Rural Clean Water Program for the past ten years in the United States. The specific section on "research needs and future vision" clearly indicates a need for improved implementation strategies for agricultural best management practices (BMPs). In order for these implementation strategies to be effective, it is crucial that education programs in these areas be monitored to determine the most efficient means of establishing diffusion practices, therefore making the adoption process as short as possible.

An RCWP project in Twin Falls County, Idaho concerning the Rock Creek stream (Gale, 1995) targeted specifically nonpoint source pollution from agricultural sources. The stream was being degraded by high loads of sediment and agricultural pollutants. After implementation of BMPs such as conservation tillage and water management, the

"sediment and phosphorus delivery to the river" was decreased by 75% and 68%, respectively. Studies such as this provide a basis for other studies in the education and implementation of BMPs which affect water quality and can provide insight into what can be accomplished in a watershed that has been degraded due to nonpoint source contaminants.

Reading E. M. Rogers' theoretical construct on diffusion/adoption, he concluded that the changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation have not been studied adequately (1983). With Rogers' conclusion under consideration, a study of the adoption process -- as it applies to the adoption of agricultural BMPs which affect water quality -- would provide greater understanding of targeted individual producers. It would as well help determine if societies within watersheds change over time with the dissemination of information used to illicit a change in attitudes and practices.

Titenberg (1992) stated that pollutants are the after effects of production and consumption and that invariably these pollutants must reenter the environment in some form. With water treated as a common property resource in the U.S. legal system and with past overexploitation of this water resource as a dumping point for waste (in the past by industry and more currently blamed on non-point sources of pollution such as agriculture), rapid adoption of BMPs as well as significant changes in past perceptions by agricultural producers can help to head off unilateral governmental regulations. These regulations might leave little room for compromise and might not provide readily available substitutions. In determining rate of adoption, diffusion and change in perceptions as they relate to water quality issues and the Cooperative Extension Service, there may be ways to improve educational methods in the instruction of environmentally sensitive topics, thus further speeding up the overall process.

PURPOSE AND OBJECTIVES

The purpose of this study was to determine the attitudes, knowledge and practices of agricultural producers in the Southwest District of Oklahoma concerning pollution sources and management practices during the first year of an educational program to establish baseline information, against which to measure change. Specific objectives of the study were as follows:

1) to determine knowledge concerning pollution sources and management practices among agricultural producers in the Southwest District of Oklahoma;

2) to determine attitudes toward the implementation of agricultural best management practices affecting water quality; and

3) to determine differences among watersheds concerning knowledge and attitudes about water quality and agricultural best management practices affecting water quality.

PROCEDURES

The instrument was developed by the State Water Quality Specialist, the Cooperative Extension Assistant Director for Agriculture, and the State Extension Evaluation Specialist. The instrument incorporated parts of several instruments which had been developed and tested for other BMP/water quality surveys including an instrument for a nationwide survey that was developed at North Carolina State University. The instrument was divided into two sections: a water quality questionnaire portion and a specific producer survey portion; the water quality portion will be considered for this paper. The full instrument for this study was submitted to a panel of experts at Oklahoma State University and amended as needed.

After instrument development, the survey of agricultural producers within the watersheds began in January, 1994. Initially, phone numbers of local agricultural

producers within the four Environmental Protection Agency 319 project funded watersheds of Barnitz Creek, Lake Creek, Whiskey Creek, and Willow Creek in southwestern Oklahoma were obtained from the local county Cooperative Extension Agricultural Agent in which the respective watershed was located. These phone numbers were used to conduct the telephone survey of the producers in the watersheds to obtain baseline data prior to an educational "push" by the Extension Service to increase the knowledge and awareness of agricultural BMPs designed to protect water quality.

A list of 209 producers was provided by county and district extension personnel which represented the target population of producers within the four watersheds. Three telephone interviewers were hired and trained (to assure consistency) by the State Extension Evaluation Specialist prior to calling producers. Of the 209 producers, telephone interviews were completed by 86 producers by April 1, 1994, when calling was ended. Of the 123 not completed, 32 declined to provide information, 30 gave convenient times to be contacted but were unavailable when contacted subsequently, 12 were no longer farming, five were wrong numbers, two had disconnected phones and two had no number. The remaining 40 had various reasons why their interviews were not completed, ranging from no answer when phoned, to someone answering but informing the interviewer that the desired contact was not at home. Most nonrespondents, who had not declined to provide information, had an attempted contact in this survey of four to five times.

The first item the respondent was asked was what they considered to be their primary commodity in production. Once the primary commodity was determined, the interviewer would go immediately to the specific producer portion of the questionnaire. After the producer portion of the questionnaire was completed, the interviewer would then ask the questions pertaining to the water quality portion of the questionnaire. The responses were recorded on a computer by the callers as they made the calls using a program written by a graduate student to record and tabulate the data. The spreadsheet

program Excel was used in data analysis. The raw data were transferred into an Excel spreadsheet for ease in data handling, Various descriptive statistics were calculated on the data to provide insight into the respondents' knowledge and attitudes for use as baseline data..

RESULTS BY WATER QUALITY SURVEY

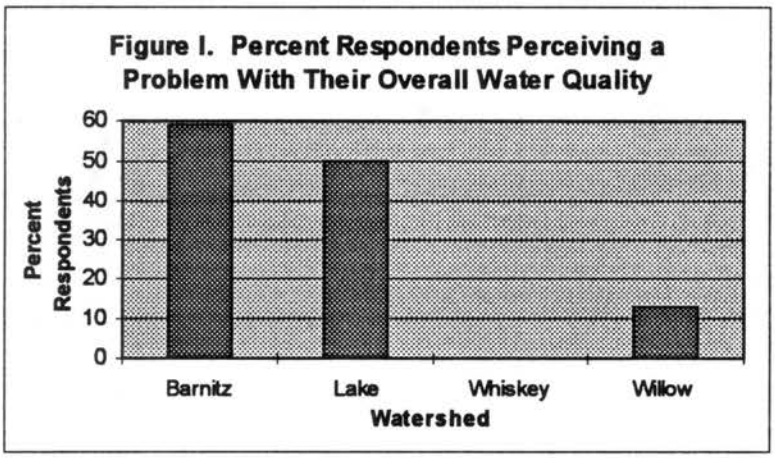
Respondents in the different watersheds had fairly similar responses to most of the questions in the knowledge of water quality section of the telephone survey. There were, however, a few interesting exceptions as will be seen in the following summary.

Of the 86 telephone interviews completed, the breakdown of respondents by watershed and crop produced is presented in Table I. As can be seen in Table I, about one-third to one-half of the producers from each watershed answered the telephone survey. Livestock producers had the largest percentage among respondents in each watershed except for Willow Creek where peanut producers dominated. Low numbers of respondents in the watersheds were found for alfalfa (4), cotton (3) and wheat (11). These low numbers within the previously mentioned crops are under some question based on the relatively low response rate expected for a telephone survey and will be compared extensively against results from subsequent surveys that are to be performed in 1996 and 1999. Nevertheless, these results will be considered for baseline data purposes.

Table I. Respondents by Watershed and Crop Produced

Watershed	alfalfa	cotton	livestock	peanuts	wheat	TOTAL
Barnitz Creek	2	3	8	0	6	19(59)
Lake Creek	2	0	3	1	2	8(23)
Whiskey Creek	0	0	14	0	0	14(30)
Willow Creek	0	0	13	29	3	45(97)
TOTAL	4	3	38	30	11	**86**(209)

As can be seen in Figure I, at least half of the respondents in Barnitz Creek and Lake Creek said there was at least somewhat of a problem with water quality in their area, but in noticeable contrast, the overwhelming majority of respondents in Whiskey Creek and Willow Creek (100% and 87%, respectively) said there was not a problem with water quality in their area. This is interesting considering Whiskey Creek was completely dominated by livestock producers and Willow Creek's producers were almost all livestock or peanut producers. Barnitz Creek and Lake Creek had a relatively more spread out distribution among the various types of agricultural production. This production difference within watersheds and individual watershed physical differences will need to be considered in the follow-up surveys to make sure the highest validity is maintained.



Over two-thirds (68-82%) of the respondents in each of the watersheds considered their water quality to be about the same at the time of the survey as it was 10 years ago. Almost all (83-100%) of the respondents in each watershed had heard at least a little about how agriculture might affect water quality. Respondents in the watersheds primarily got their information about water quality from farm magazines, newspapers, and the Extension Service.

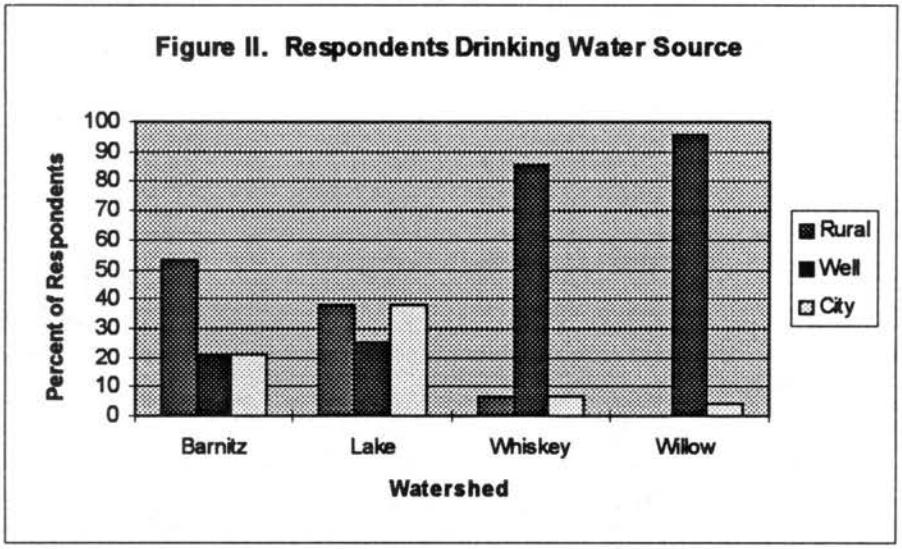
The most commonly perceived causes of water pollution in the watersheds are presented in Table II. Types of pollution were separated into agricultural pollution and

nonagricultural pollution to better identify producers' perceptions of pollutants which affect water quality. At least one-third and up to over one-half of the producers within each watershed perceived agricultural sources as the major sources of water pollution in their areas. But, at the same time, an overwhelming majority of respondents (75-93%) within each watershed said that water pollution was not a problem on their particular farm. So, it appears that producers are willing to acknowledge agricultural pollution as a major cause of diminishing water quality, but, they do not perceive themselves, individually, as the source of the pollution.

Table II. Within Producer's Area: Specific Perceived Causes of Water Pollution

Source	Barnitz	Lake	Whiskey	Willow
Agricultural	cropland runoff (21%) fert. or pest. (16%)	fertilizer (50%)	fert. or pest. (36%) cropland runoff (14%) livestock waste (7%)	cropland runoff (20%) fert. or pest. (14%) livestock waste (2%)
Nonagricultural	oil flds/inj. wells (32%) litter/garbage (11%)	oil flds/inj.wells (25%)	litter/garbage (14%) oil flds./inj.wells (7%)	oil flds./inj. wells (18%) litter/garbage (13%) landfill (2%)

The most common sources of drinking water for respondents is presented in Figure 2. Quite obviously, most respondents rely on rural or well water as their sources for drinking water.



The majority (53-73%) of the respondents within each watershed said they were not concerned about the pollution of their own drinking water as is evidenced in Table III. Most of those who responded were not concerned about bacteria or pesticides in their drinking water. Similar responses were found on concern about nitrates in the drinking water, except for Lake Creek, where 100% of the respondents had at least some concern about nitrates in their drinking water. Overall, though, approximately one-quarter of the respondents had some level of concern about the contaminants under question.

Table III. Percent of Respondents Concerned About Contaminant in Their Drinking Water

Contaminant	Barnitz	Lake	Whiskey	Willow	TOTAL%
bacteria	42%	0	36%	20%	26%
nitrates	42%	100%	29%	20%	34%
pesticides	32%	26%	29%	22%	23%

Those who had unused mixed pesticides disposed of them by using the methods presented in Table IV. Many of the respondents did not have unused mixed pesticides left over for disposal because they used a custom applicator. Most of the respondents did dispose of their mixed unused pesticides in acceptable manners or did not report their method of disposal. Four respondents (5%), however, did report using unacceptable practices which would have adverse effects on water quality.

Table IV. Respondents' Method of Disposal of Unused Mixed Pesticides

Disposal Method	Barnitz	Lake	Whiskey	Willow
Acceptable				
-use next treatment	21%	0	7%	18%
-spray on labeled site	16%	13%	29%	27%
-landfill	16%	0	0	0
-follow recommendations	0	0	0	4%
Unacceptable				
-bury	5%	13%	0	2%
-pour out	0	0	0	2%

Respondents methods for disposal of old, unused pesticides are presented in Table V. Most respondents reported using commercial applicators or some "other" unidentified method for disposing of old, unused pesticides. Most of those respondents who did report a method of disposal for old, unused pesticides did use an acceptable method, however, those who reported using an unacceptable method was greater (14%) as compared to those who reported an unacceptable disposal method for unused mixed pesticides.

Of the 44 respondents who gave specific information as to where they mixed their pesticides, over half (59%) said they mixed pesticides in an acceptable location (i.e. in the field, away from water source, or cooperative mixed pesticides); the other 41% reported

mixing their pesticides in an unacceptable location (i.e. beside storage shed, beside or within 50ft of a well, or beside creek/pond).

Table V. Respondents' Method of Disposal of Old, Unused Pesticides

Disposal Method	Barnitz	Lake	Whiskey	Willow
Acceptable				
-use next treatment	11%	0	21%	18%
-landfill	16%	0	0	0
-store them	0	0	0	9%
-return to dealer	0	0	0	7%
-follow recommendations	0	0	0	2%
Unacceptable				
-bury	5%	13%	0	4%
-pour out	16%	13%	0	7%
-burn	0	0	0	2%

Over three-fourths of all respondents, at least sometimes, triple or pressure rinsed empty liquid pesticide containers before disposal. Over three-fourths of the respondents did not have a special pad to contain spills when mixing/loading pesticides. One-half to three-fourths of the respondents within individual watersheds did have cost-sharing or incentive programs through ASCS or SCS contracts. Over half of the respondents within Barnitz Creek and Lake Creek were at least somewhat familiar with the term "best management practices", while in Whiskey and Willow Creek watersheds, over half of the respondents said they were not familiar with the term.

Within Table VI, the number of respondents are given who had the indicated level of agreement with the presented statements (the other respondents were either neutral or did not respond to the statement).

Table VI: Water Quality Attitudes by Watershed

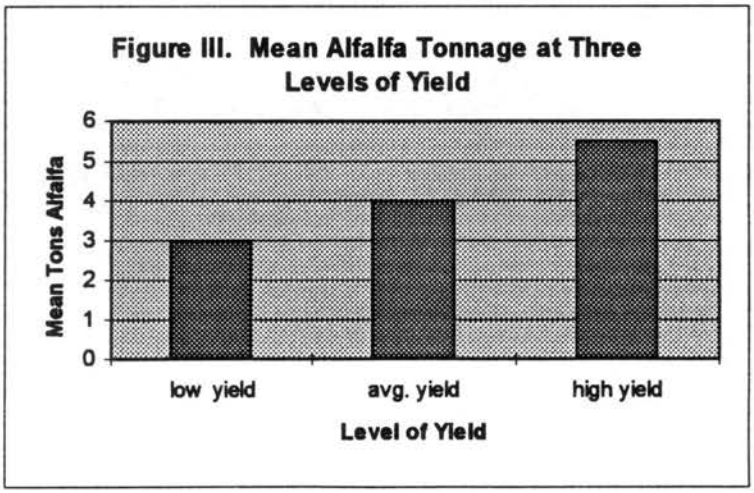
Statement	Barnitz	Lake	Whiskey	Willow	TOTAL
--Farm Practices that protect water quality usually require more labor.					
agree	9	6	8	29	52
disagree	6	2	2	12	22
--Agricultural water pollution is a serious threat to fish and wildlife.					
agree	7	4	7	25	43
disagree	10	4	5	14	33
--Agriculture is being unfairly blamed as a cause of water quality problems.					
agree	10	7	10	33	60
disagree	4	0	1	4	9
--If farm operators don't do more to protect water quality on their own, the government will force them to, through regulation.					
agree	15	8	14	42	79
disagree	2	0	0	1	3
--The government should help pay for water pollution control on farms.					
agree	9	5	9	23	46
disagree	6	3	2	12	23
--Farm operators have the right to farm any way they choose, even in ways that damage water quality.					
agree	1	0	1	5	7
disagree	14	8	12	36	70
--Land owners have a responsibility to farm in ways that protect water quality.					
agree	15	8	14	37	74
disagree	1	0	0	3	4
--Water pollution can best be controlled through farm operators' use of BMPs.					
agree	11	8	5	31	55
disagree	0	0	0	0	0
--Pesticides are harmful to water quality.					
agree	12	6	13	30	61
disagree	3	0	0	7	10
--Fertilizers are harmful to water quality.					
agree	11	6	11	24	52
disagree	4	0	0	11	15
--Pesticides are more harmful to water quality than fertilizers.					
agree	9	3	11	27	50
disagree	3	2	0	7	12
--Most of the farmers in my area are very concerned about water quality.					
agree	11	5	9	34	59
disagree	3	3	3	5	14
--Waste disposal is a concern on many farms and ranches in my area.					
agree	7	3	11	18	39
disagree	5	5	1	17	28
--I am more concerned about water quality now than I was five years ago.					
agree	15	5	11	26	57
disagree	2	2	1	13	18

RESULTS BY COMMODITY PRODUCED SURVEY

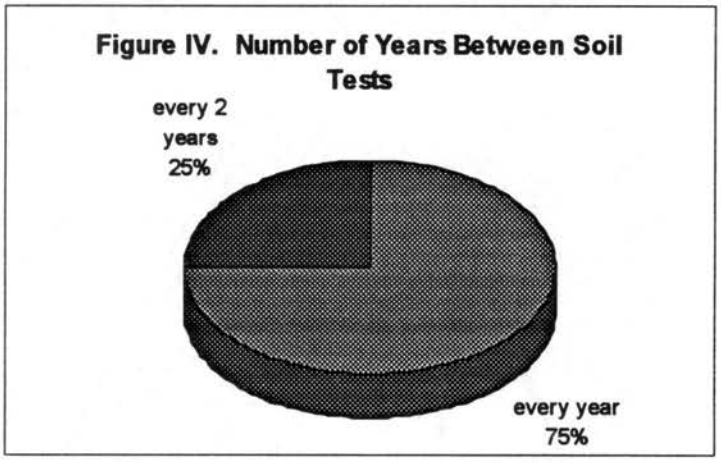
As was stated earlier, after the interviewer determined what was the primary commodity produced by the producer, they immediately went to the commodity appendix portion of the questionnaire to determine specifics about practices and knowledge of the farmers as they related to the specific commodity produced. Table I, at the beginning of the previous section, showed the breakdown of respondents by watershed and commodity produced. The commodities represented included alfalfa, cotton, livestock, peanuts and wheat; the results of commodity portion of the survey will be reported based on commodity produced.

Alfalfa

There were only 4 respondents that reported alfalfa as their primary crop produced and they were from Barnitz or Lake Creek. Two of the farmers reported their total alfalfa acreage: one reported 300 acres and the other reported 450 acres. The mean alfalfa yields for the 4 alfalfa producers at low, average, and high levels are reported in Figure III.



How often respondents had their soil tested is presented in Figure IV. All of the respondents said they follow the results of the soil tests at least partially. Two of the respondents said they always follow the results of the soil tests.



Respondents indicated, as presented in Table VII, the levels of nutrients that they applied to their alfalfa crop.

Table VII. Nutrients Applied to Respondents Alfalfa Crop

Nutrient	Number Respondents	Rate (lbs/acre)
Nitrogen	1/4	No Rate Reported (NRR)
Phosphate	3/4	45, 100, NRR
Potash	2/4	100, 120

In Table VIII, respondents alfalfa pest problems are shown and the pesticides used to control these pests are described. All respondents reported scouting their fields to determine when to apply pesticides. One respondent said it took 1.5 minutes to scout 10

acres of alfalfa and another respondent said it took 15 minutes to scout 10 acres. Two farmers gave no response as to how long it took them to scout 10 acres of alfalfa

Table VIII. Respondents' Alfalfa Pest Problems and Pesticides Used to Control Those Pests

Type of Pest	Number of Respondents	Pesticide Used
Insect		
alfalfa weevil	1	methyl parathion
none	3	n/a
Weeds		
mustard	1	Velpar
NRR	3	Velpar, Treflan
Diseases		
none	1	n/a
NRR	3	NRR

Cotton

As with alfalfa, there were a small number of respondents who produced cotton as their primary crop (3 producers). The three producers had acreages of 48, 120, and 500 committed to cotton production, of which all was dryland cotton. Mean cotton yields for the 3 cotton producers at low, average and high levels are presented in Figure V.

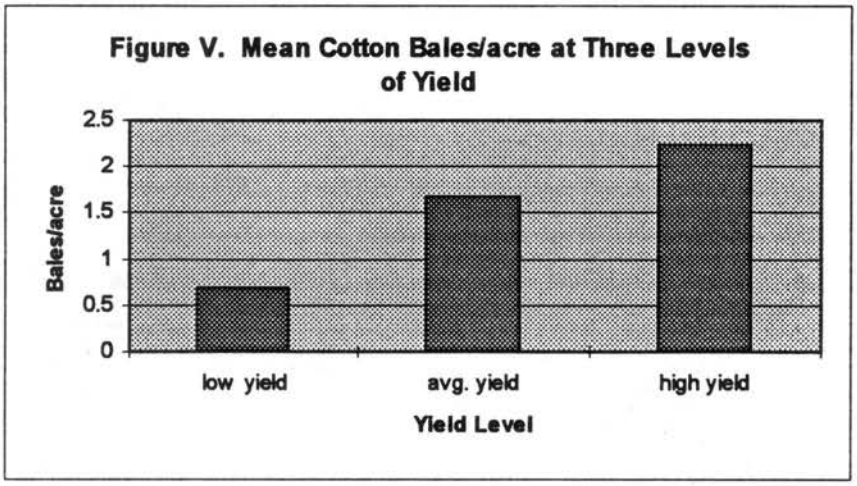
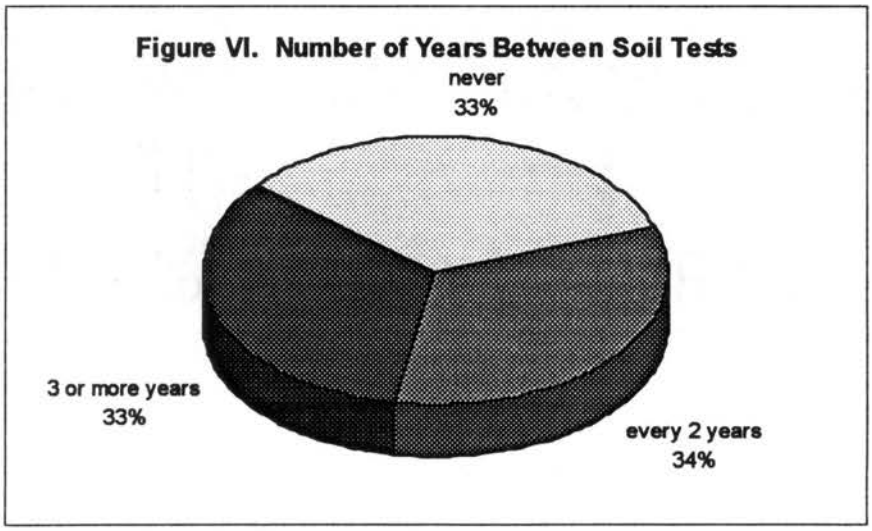


Figure VI describes the amount of time between soil tests for the cotton producers. It appears that the cotton respondents have their soil tested less often than the alfalfa respondents and one cotton farmer never had his soil tested which goes strongly against established recommendations. It should be noted also that the farmer that did not have soil tests performed did not fertilize his cotton fields. The cotton producers that did have their soil tested said they followed the recommendations of those tests. Of the two farmers that did fertilize their cotton, both used nitrogen at 30 and 45 lbs/acre,



respectively; both also used phosphate at 30 lbs/acre; and one used potash at a rate of 20 lbs/acre. All three producers used clean till as their tilling method which goes against water quality protection recommendations for tilling practices.

Table IX describes the cotton producers' pest problems and their pesticide usage to control those reported pests. One cotton producer decided when to apply pesticides by scouting fields at a rate of 30 minutes for 10 acres. Another cotton farmer said he had his Extension Agent determine when to apply pesticides. The third farmer said he used some "other" unspecified manner to determine when to apply pesticides to his cotton fields.

All three farmers reported using crop rotation with their cotton crop, but did not give specifics on what crops were rotated with their cotton. One farmer reported using a winter cover crop of wheat on his cotton field. Another farmer said he would be in favor of a boll weevil eradication program while the other two farmers said they would not be in favor of the program.

Table IX. Respondents' Cotton Pest Problems and Pesticide Used to Control Those Pests

Type of Pest	Number of Respondents	Pesticide Used
Insect		
boll weevil	1	NRR
thrip	1	Temik
none	1	n/a
Weeds		
morning-glory	2	Caparol, Roundup
horsenettle	1	Treflan
Diseases		
wilt (unspecified)	1	Didn't know
none	2	n/a

Livestock

The 38 livestock producers who answered the survey represented all four watersheds. The average number of acres livestock producers had in livestock production was 987.5 with a range from 93 to 5,000 acres. The total livestock acres in this survey was 37,526.

Figure VII presents the percentage of producers raising different types of livestock. As is indicated in the figure, most (71%) of the livestock producers were cow/calf operators.

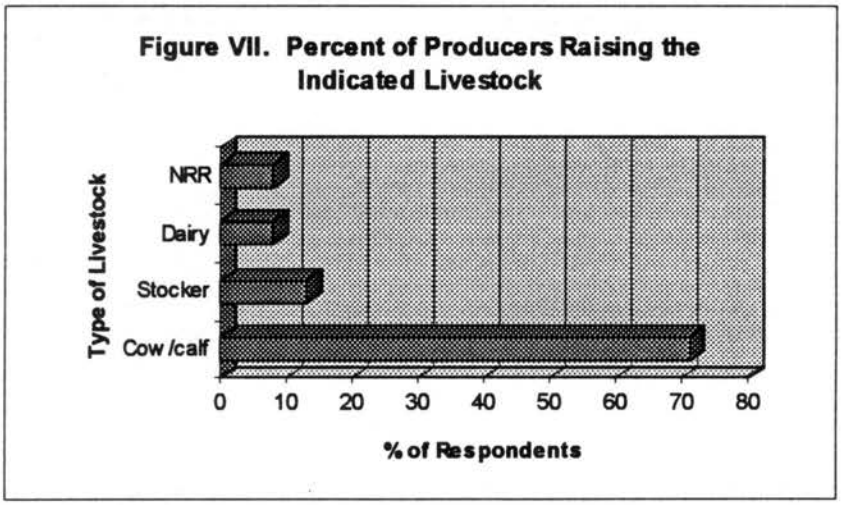
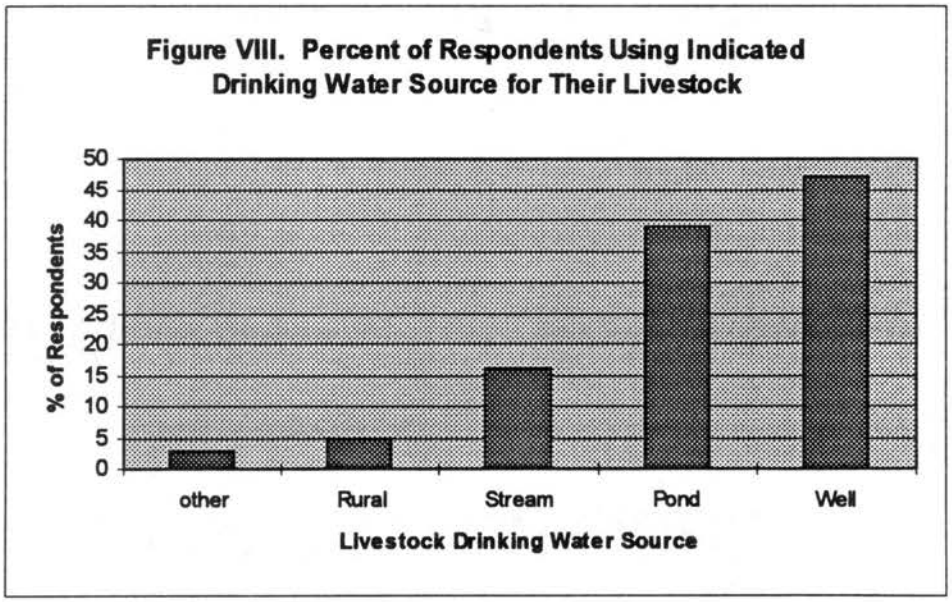


Table X shows the average number, range, number confined and totals for the livestock under each type livestock being produced. The largest total number of livestock was under cow/calf production and the highest number of confined livestock was under stocker cattle with 501 cattle confined. The large ranges of animals in each type of production indicates varying levels of part-time and full-time livestock producers.

Table X. Demographics for the Livestock Under Each Type of Livestock in Production

Livestock Type	Average # head	Range	# confined	Total #
Cow/calf	255	20-1150	36	6892
Stocker	228	42-500	501	1142
Dairy	113	60-200	7	340

As can be seen in Figure VIII, livestock producers used a variety of primary drinking water sources for their livestock with significant percentages using streams (16%) and ponds (39%). Extremely intriguing, though, is the 92% of livestock producers who allow their livestock free access to streams and/or ponds. Most of this 92% did not report streams and/or ponds as the primary drinking water source for their livestock which could have a significant impact on local surface water quality.



One half of the livestock producers had heard of EPA's Confined Animal Feeding Operations (CAFO) regulations which included all three of the dairy producers. Of those

that had heard about CAFO regulations, 42% had heard about them from other farmers/neighbors, 26% had heard about them from farm magazines, 11% had heard about them from the Extension Service or some other method, respectively, and 5% had heard about them from newspapers or ASCS/SCS, respectively. Almost all (97%) of the livestock producers said CAFO regulations had not affected their operation. The producer who said CAFO had affected his farm did not indicate what type of livestock he produced. Over one-third (35%) of the producers, including the three dairy producers, thought CAFO regulations would possibly cause them to make changes in their operation in the future. One-fourth (26%) of the livestock producers thought CAFO regulations would cause financial hardships to their operations in the future. All three of the dairy producers thought CAFO regulations would cause them future financial hardships. One dairy producer thought it would cost $10,000 while another dairy producer thought it would cost them $30,000 in cost under CAFO regulations. Over one-third (37%) of the livestock producers thought CAFO or some similar type of regulations has possible value to the environment which included representation from cow/calf, stocker and dairy livestock producers.

One dairy producer and one cow/calf producer had lagoons or waste storage ponds for animal waste. The dairy producer's lagoon/storage pond was designed by SCS, it was 2 years old, 1 acre in size, and, it had not had effluent pumped out of it. The producer did expect, in the future, to pump effluent out of it, though. The lagoon/storage pond under consideration, also, had not run over in the past. Representatives (26%) from all of the types of livestock production reported were concerned about manure disposal.

Peanuts

There were 30 producers who identified themselves as primarily peanut producers. They had an average acreage of 147 acres in peanut production with a range of 13 to 350

acres among them. The total acreage of producers who primarily considered themselves peanut producers was 4,403 acres. Peanut producers were from Lake and Willow Creeks. Three peanut producers had dryland peanuts while all 30 respondents had irrigated peanuts in production. No average yield data was reported for the peanut producers.

Figure IX shows the percentage of peanut producers who had their soil tested at the indicated time intervals. As can be seen, one-half of the peanut producers had their soil tested every year. All of the peanut producers who had their soil tested followed the recommendations from the results of soil tests. Ten percent of the peanut producers never had their soil tested which goes against established recommendations. Of the 3 farmers that did not have their soil tested, one farmer used the advice of the fertilizer dealer and the other two farmers indicated they "used what I have always done" to determine how much fertilizer to apply.

Figure IX. Percent Peanut Producers Who Have Their Soil Tested at the Indcated Interval

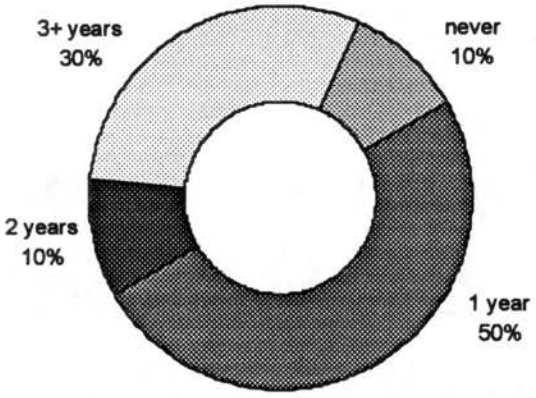


Table XI indicates the plant nutrients the indicated percentage of farmers applied annually to their peanut crop; it also shows the range and average rate of each nutrient where appropriate.

Table XI. Percent of Peanut Farmers Applying the Indicated Nutrient to Their Peanut Crop

Nutrient	% Respondents (#)	Rate Range (lbs/acre)	Rate Average
Phosphate	67%(20)	15-150	50.4
Potash	60%(18)	10-200	56.6
Zinc	3%(1)	<10	n/a
Gypsum	3%(1)	2000	n/a
Lime	3%(1)	NRR	n/a
Other	3%(1)	NRR	n/a

In Table XII the peanut producers pest problems are indicated and their pesticides used to control those pests are presented. As far as pests were concerned, the largest percentages of peanut producers had trouble with spider mites (40%), pig weed (40%) and blight (90%). To determine when to apply pesticides, peanut farmers scouted fields (47%), used consultants (27%) or used some "other" method (27%).

Table XII. Respondents' Peanut Pest Problems and Pesticides Used to Control Those Pests

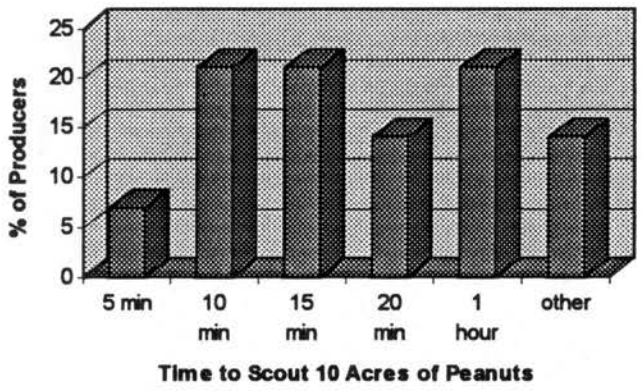
Type of Pest	Percent of Respondents	Pesticide Used (# producers)
Insect		
spider mite	40	Comite (1)
thrip	13	Orthene (1), Temik (1)
nematodes	10	Temik (1)
leaf hopper	7	NRR
aphids	3	NRR
no problem	20	n/a
NRR	7	n/a

Table XII. Continued

Type of Pest	Percent of Respondents	Pesticide Used (# producers)
Weeds		
pig weed	40	Dual (1), Pavlon (1), Prowl (3) Pursuit (3), Treflan (2), 2-4D-B (1)
crabgass	23	Balan (1), Prowl (2) Preemerge (1), Treflan (3)
sunflower	17	Prowl (2), Pursuit (1)
yellow nutsage	10	Balan (1), Basagram(1)
Tx Panacam grass	3	Post (1)
love grass	3	Balan (1)
sickle leaf spur	3	Prowl (1)
Johnson Grass	3	NRR
NRR	3	n/a
Diseases		
blight	90	Rovral (2), Terraclor (1)
leafspot	20	Dithane Manzate (1)

Those who scouted fields could scout ten acres of peanuts in the times indicated in Figure X. As can be seen from the figure, of those peanut producers who scouted their fields most did not spend the recommended amount of time to scout their fields properly.

Figure X. Percentage of Producers Using the Indicated Time to Scout Ten Acres of Peanuts



Most respondents, 60 percent dryland and 90 percent irrigated, rotated other crops with their peanut crop. Table XIII shows what crops peanut farmers rotated with their peanut crop.

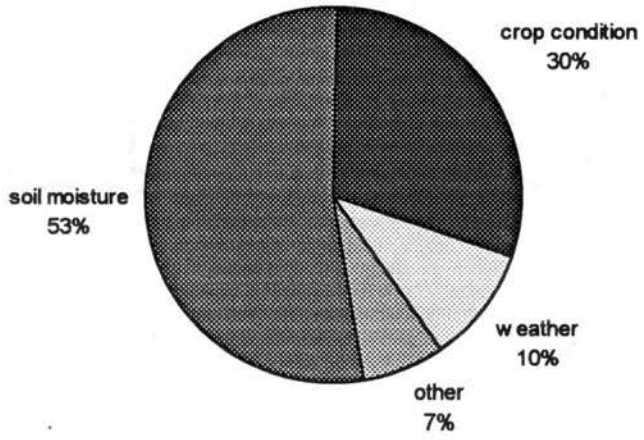
Table XIII. Crops Rotated With Respondents' Peanut Crop

Crop Rotated	Percentage of Respondents
wheat	56
milo	44
cotton	26
corn	15
grasses	11
alfalfa,	4
Hybrid Sudan,	4
watermelon	4
NRR	11

All of the peanut producers irrigated their peanuts. The average number of irrigated peanut acres per respondent was 140 with a range of 13-350. Almost all (97%) of the irrigation water producers used for their peanuts came from wells. Only one

respondent had a problem with their irrigation water and that problem was one of hard water. A few peanut farmers (13%) did use chemigation or fertigation, but did not report any methods used to prevent backflow. Figure XI shows how peanut producers decided when to irrigate their peanut crop. Most (53%) peanut producers used soil moisture to determine when to irrigate.

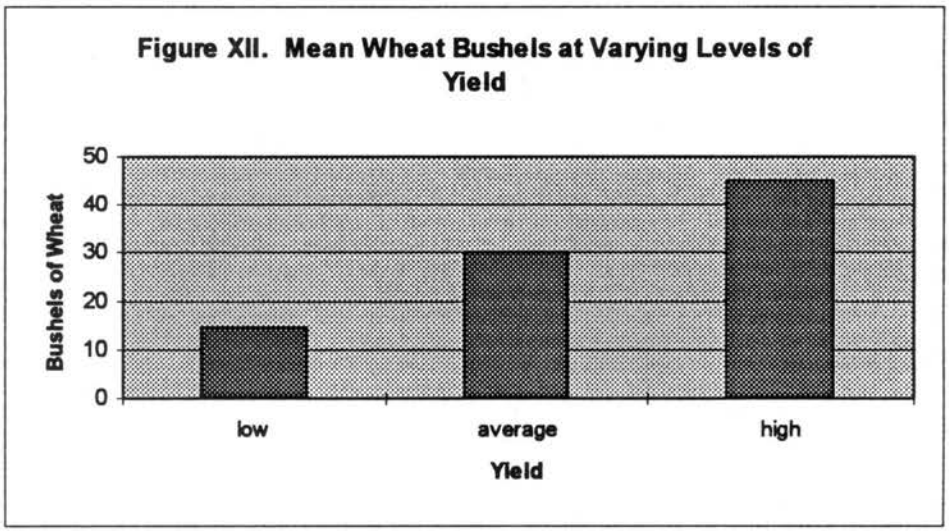
Figure XI. Producers' Method for Determining When to Irrigate Their Peanut Crop



All of the peanut producers used a winter cover crop with their peanuts. Most farmers used wheat (93%) or Rye (50%) as their winter cover crop. Aside from the norm, one farmer used vetch and another farmer used sorghum as their winter cover crop.

Wheat

There were 11 wheat producers in the survey representing all four watersheds. Their average number of wheat acres in production was 601 with a range of 100-1,000. The total number of acres in wheat production as reported by the wheat producers was 6,615. The mean yield of wheat at low, average and high yields is presented in Figure XII.



As can be seen in Figure XIII, most wheat producers had their soil tested every three or more years. Of those wheat producers who did have their soil tested 90 percent of them followed the recommendations of the soil test at least partially. One farmer said that they never had their soil tested

When asked what tillage system they used for their wheat crop, the wheat producers gave the responses as indicated in Table XIV. It is interesting to note that with most (54%) of the wheat producers reporting using either minimum till or stubblemulch as their tillage system, that the average numbers of tills used by the producers would be 3.6 with a range of 2-5 tillages.. This seems like a high average till based on the results of the tillage system used. The 3.6 average indicates that most of the producers use four or five tillages which does not agree with the tillage systems reported. Farmers (82%) reported applying nitrogen at an average rate of 84 lbs/acre with a range of 45-100 lbs/acre to their wheat crop. A lesser percentage (18%) reported using some "other" unidentified nutrient to their wheat.

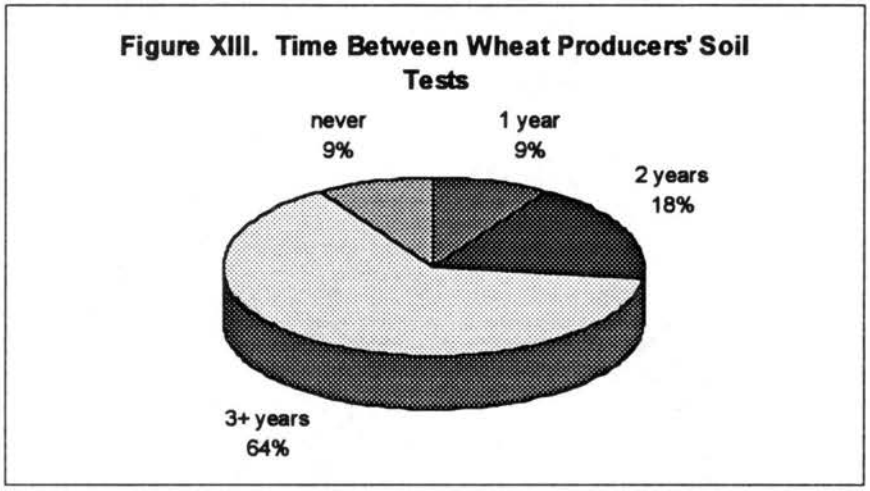


Table XIV. Percentage of Wheat Producers Using the Indicated Tillage System

Tillage System	Percent of Respondents
minimum till	36
stubble mulch	18
clean till	9
other	36

Wheat farmers were asked to report their primary wheat pest problems and their choice of pesticide for controlling those reported pests; their responses are included in Table XV. All eleven of the wheat farmers reported a problem with aphids in their wheat crop and seven of those farmers used Dimethoate to control aphids.

Table XV. Wheat Farmers Reported Pest Problems and Their Pesticide Used to Control Pests

Type of Pest	# of Respondents	Pesticide Used (# producers)
Insect		
aphid	11	Dimethoate (7)
Weeds		
cheat	3	Banvel (1), None (2)
mustard	2	Glean (2)
Kochia	1	Glean (1)
bindweed	1	2, 4-D (1)
don't know	2	NRR
none	2	n/a
Diseases		
rust	2	NRR
root rot	2	none (1)
Mosaic	1	none (1)
smut	1	NRR
none	5	n/a

To determine when to apply pesticides, five farmers scouted their fields, 1 farmer used their Extension Agent, another farmer used a consultant, and the other farmer used some "other" method or did not report a method. Of those wheat farmers that scouted their fields, two farmers said it would take them 10 minutes to scout 10 acres of wheat while one respondent each said that they could scout 10 acres of wheat in 15 minutes, 30 minutes, or could just drive by their field, respectively. Over half (55%) of the wheat producers did not rotate crops with their wheat. Of the five farmers who did rotate crops with their wheat; the first farmer rotated hay; the second farmer rotated milo; the third farmer rotated cotton or peanuts; the fourth farmer rotated cotton, milo or peanuts; and the fifth farmer rotated alfalfa or cotton. Ten of the eleven wheat farmers had terraced

wheat land with an average amount of land terraced at 82.5 percent with a range of 15-100 percent.

CONCLUSIONS

Producers perceived little or no water quality problems on their farms or in their area except those in the Lake Creek watershed, who perceived nitrate problems. Producers did, though, perceive problems with their overall water quality in at least two of the watersheds and this perception may be due to production differences between the watersheds. According to the Draft Groundwater Management Plan (Oklahoma State Department of Agriculture, 1996), all of the watersheds have potential nitrate problems. Producers, for the most part, used acceptable practices for disposal of unused/old pesticides, but education is still needed to inform the minority of producers who still use unacceptable practices which deteriorate water quality. Perceived sources of water pollution were very accurate based on other sources of that information, indicating the respondents had good knowledge of pollution sources. Overall, the producers were not very familiar with the term, "Best Management Practices". Interestingly, though, the producers considered the use of BMPs as the best way for farmers to protect water quality. Finally, producers think agriculture is a source of contamination to water quality, but do not think of themselves, individually, as the blame for the problem.

EDUCATIONAL, SCIENTIFIC, AND PRACTICAL IMPORTANCE OF THE STUDY

This study forms the baseline against which to measure change in knowledge and attitudes toward water quality and agricultural best management practices which affect that water quality by the agricultural producers in four watersheds in southwest Oklahoma. The educational importance of the study is that it provides valuable

information about this knowledge and these attitudes in addition to providing baseline information against which to measure change. As an educational needs assessment, agricultural educators can use this information to shape programs more specifically to the desired target audience. Scientifically, it adds to the knowledge base about producer perceptions of water quality. Practically, it is imperative to have this information if change, diffusion and adoption is to be measured in the watersheds of interest. If we are to know the impact of Extension educational programs on such critical issues as water quality, studies like this one are essential.

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CHAPTER III

AGRICULTURAL PRODUCERS' KNOWLEDGE AND PERCEPTIONS OF WATER QUALITY: AN OKLAHOMA WATERSHED LONGITUDINAL AND DESCRIPTIVE STUDY

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INTRODUCTION AND THEORETICAL FRAMEWORK

There has been much emphasis, regulation and reporting on agriculture's effects on water quality during the last several years. Educational efforts have been made by state and federal agencies to try and change the perceptions of agricultural producers in areas where water quality improvement is desired. Much of these educational efforts have specifically targeted farmers' perceptions on adoption of certain Best Management Practices (BMPs).

Financial incentives were often used to a large degree in the past and into the present to try to change farmers' practices. These incentives, basically, offset the costs to the farmer so it was easier and more affordable for the farmer to implement a new practice such as terracing or setting aside marginal lands for set periods of time. What

was hoped by the funding agency was that after the management practice was paid for and implemented, farmers would see the benefit and continue to use the particular practice. Today, with funding decreases in programs such as the Conservation Reserve Program and the desire of funding agencies to limit repetitive projects, new ways of getting farmers to adopt BMPs have need for development.

Government regulations and policies concerning water quality in the U.S have been inefficient and/or ineffective on many fronts including: pesticide bans (Zilberman et al, 1991), lack of cost-benefit, uniform regulations, and subsidies (Freeman, 1990). Inefficient/ineffective regulations and policies can unnecessarily raise prices to consumers and hurt agricultural producers' competitiveness on the world market (Abler and Shortle, 1995).

Educational programs may be a viable alternative to financial incentives in changing farmers' perceptions towards BMPs (Feather and Amacher, 1994). In addition, educational programs are possibly a more cost-effective alternative to both financial incentives and direct regulation.

Farmers have indicated that educational programs, such as field demonstrations and county meetings, are useful techniques when disseminating water and soil conservation information (Bruening and Martin, 1992). Farmers have, then, seemed to be indicating that they would use information presented at educational programs to weigh in their decision processes.

Local agricultural producers have been targeted for water and environmental quality educational projects by state and federal agencies. But, have these educational

efforts changed farmers' practices and/or attitudes concerning water quality issues and are the targeted groups actually "hit".

PURPOSE AND OBJECTIVES

The purpose of this study was to determine the attitudes and practices concerning water quality of agricultural producers in the Barnitz Creek Watershed in Custer County, Oklahoma. Specific objectives of the study were as follows:

1) to determine producer knowledge and attitudes concerning water quality;

2) to determine any change in producer knowledge and attitudes over time concerning water quality; and

3) to determine producer practices that impact water quality.

METHODS AND PROCEDURES

The Barnitz Creek watershed is located in Southwest Oklahoma almost entirely within Custer County having only a small area in its northern most drainage in Dewey County. It is an Environmental Protection Agency 319 project identified watershed having potential nonpoint sources of water pollution. In 1994, a baseline telephone pre-survey was conducted in Barnitz Creek Watershed within Custer County along with three other watersheds in Southwest Oklahoma (Key and Pierce, 1996). The 1994 survey was designed through several of its questions to separate the respondents based on the primary agricultural product they produced: alfalfa, cotton, livestock, peanuts or wheat.

So, many respondents did not get the opportunity to answer certain questions because of the primary crop/product they indicated they produced. Therefore, the 1994 survey did not get answers from respondents based on the multiple agricultural products being produced on their farms. A section of this 1994 survey, however, used a 5-level Likert type scale to determine agricultural producers' attitudes based on 14 statements related to water quality. All 1994 respondents answered this portion of the survey. Twelve of these 1994 statements were chosen exactly as they appeared in 1994 to be used in the 1997 follow-up survey's section on agricultural producers' attitudes. The 1994 attitude responses for Barnitz Creek were compared to the 1997 responses to the same 12 statements.

The overall 1997 Agricultural Producer Survey on Water Quality for Barnitz Creek Watershed was adapted from the 1994 survey instrument, which was developed by the State Water Quality Specialist, the Cooperative Extension Assistant Director for Agriculture, and the State Extension Evaluation Specialist. The 1997 survey was adapted from the 1994 survey by the State Water Quality Specialist, the State Evaluation Specialist, the Custer County Extension Director and the Experiment Station Research Associate. The 1994 and 1997 surveys were reviewed by a panel of experts and modified as needed.

During the period between the 1994 survey and the 1997 survey several educational efforts were undertaken by the Oklahoma State University Cooperative Extension Service in Custer County and in Barnitz Creek, specifically. These efforts included at least programs/activities on the following: cotton crop diaries and field histories; cotton Ro-Till emphasis; soil sampling; cotton demonstration plots;

conservation compliance; water quality steering committee formation; wheat demonstration plots (IPM, nitrate management and variety); posting of peanut fact sheets; and development of individualized cotton BMPs.

The 1997 survey population, as identified by the Custer County Agriculture Extension Agent, consisted of the agricultural producers in the majority portion of Barnitz Creek Watershed within Custer County. The 1997 population was identified as having 69 individual agricultural producers. Many of these 69 were determined to be retired and/or not farming anymore. Also, several of these identified individuals were the landowners, but another agricultural producer of the 69 was farming the landowner's property at the time the survey was conducted.

Initially, the survey was mailed out to the 69 agricultural producers by the Custer County Agriculture Extension Agent followed up by a second mailing and one set of phone call reminders. The mail-out effort combined with the second mailing and follow-up phone call resulted in the return of only two surveys.

It is interesting to note that the phone survey in 1994 only resulted in a 32.2 percent (19 of 59) response rate, with non-respondents receiving 4 to 5 phone calls if not indicating that they did not want to participate. It was suggested by members of the Extension Service that Barnitz Creek had been saturated in the near past with surveys and that the agricultural producers indicated a desire for the practice of surveys to end.

Out of the initial population of 69 producers in 1997, 27 usable surveys were completed for a total of 39.1 percent of the initial 69 producers. These 27 producers probably made up a much higher percentage of the actual producers who were actively farming or ranching the land in Barnitz Creek Watershed as some producers had retired.

The survey technique that worked best in 1997 was the interview survey. The Custer County Extension Director sat in the local coffee shop and asked the agricultural producers to sit down with him and answer the survey questions. The Extension Director filled out the survey as the individual producer answered the questions. The Extension Director applied this strategy for one month, going to the coffee shop at breakfast and lunchtime. The data from the surveys were entered into the Excel spreadsheet program and statistical analysis was performed using the Excel statistical package. Descriptive statistics and t-tests were performed. T-tests were performed to determine mean differences between responses on the 1994 survey conducted in Barnitz Creek and the 1997 Barnitz Creek survey. An alpha level of 0.05 was used to determine statistical significance.

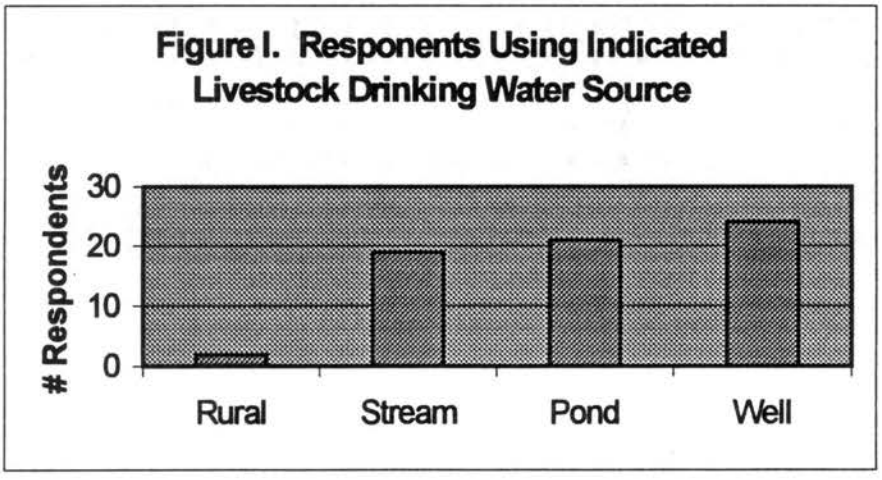
RESULTS

Out of the 27 usable 1997 surveys, 26 respondents reported their total acres farmed with a mean acreage of 1,462.3, a range from 200 to 3,800 acres and median of 1,160 acres. The number of acres farmed was not found to be statistically different from the group who responded in 1994 that averaged 1303.4 acres farmed. When asked to indicate what percentage of farming income came from various agricultural areas, the 1997 respondents indicated the results seen in Table I. Of the 1997 livestock producers, 18 also produced wheat and the other 3 produced either alfalfa, alfalfa/cotton or "other". The 22 respondents that reported herd size averaged 393 head with a range of 50-1000 head (one of these respondents raised horses).

TABLE I. Percent of Farming Income Earned by Particular Agricultural Area

Agricultural Area	Mean Percent Income	Range Percent	# Respondents
alfalfa	22.5	5-40	14
cotton	22.5	10-55	10
livestock	50.5	20-90	21
wheat	36.2	10-80	21
other	50	N/A	1

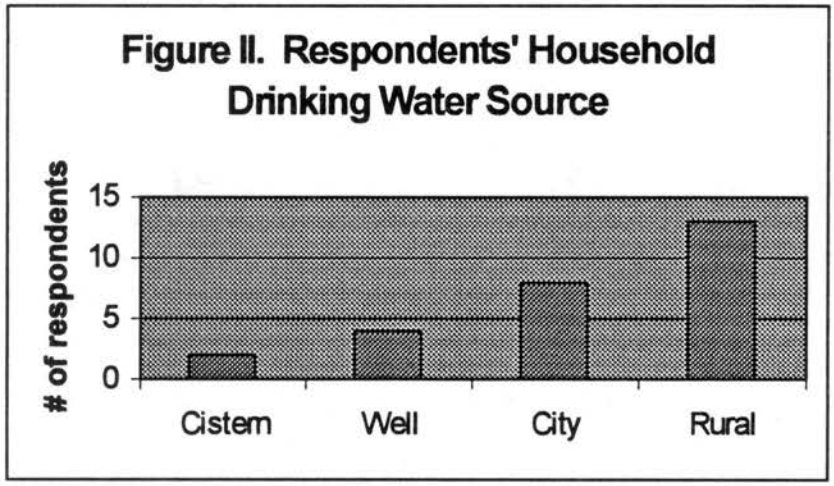
When the 1997 livestock respondents were asked to indicate the sources of drinking water for their livestock they gave the results seen in Figure I. The 1994 survey showed 16 percent of livestock producer respondents within 4 Southwest Oklahoma Watersheds, including Barnitz Creek, using streams as the primary livestock watering source. The 1997 survey showed 90.5 percent of livestock producer respondents using streams as a livestock watering source within Barnitz Creek Watershed. So, the 1994 survey probably under reported the true use of streams as a livestock watering source among those respondents.



In 1997, 23 respondents of 24 indicated that their livestock had free access to streams and/or ponds for 96 percent of respondents. In 1994, 92 percent of livestock respondents among the four watersheds surveyed indicated that their livestock had free access to streams and/or ponds. BMPs suggest that livestock should have no access to streams and limited access to ponds through structures such as floating fences.

In 1997, 5 of 24 respondents (20.8 percent) indicated that they were concerned about manure disposal. Twenty-six percent of the 1994 four-watershed-livestock-respondents were concerned about manure disposal. In 1997, one respondent indicated having a lagoon/waste storage pond while in 1994, 2 respondents indicated having lagoons/waste storage ponds. When asked in 1997 how Confined Animal Feeding Operation (CAFO) Regulations had affected their operations, one respondent indicated that they had changed their feed lot usage and another respondent said that they had stopped feeding their livestock in one place. One respondent in 1994 said that their operation had been affected by CAFO. A little less than half (45.8 percent) of 1997 respondents said that they thought CAFO regulations "help improve the environment", while in 1994, 37% of the livestock respondents thought CAFO regulations "have value to the environment".

Respondents in 1997 had as their household drinking water source the results shown in Figure II. These results are similar to 1994 in Barnitz Creek, however, there was no cistern use recorded in 1994.



Six respondents from the 1997 survey said that they had some problem with their drinking water including the following problems: nitrate (1), pesticides (1), hard water (2), gypsum (2), and other (1). When asked to indicate the last time household drinking water had been tested, the respondents provided the information in Table II. Interestingly, 4 out of the 6 respondents who had replied that they did have drinking water problems had their water tested in the last 5 years. The other two respondents could not remember the last time they had their water tested.

TABLE II. Respondents' Most Recent Testing of Household Drinking Water

Year	# Respondents	Problem
1997	1	gypsum
1996	3	hard (1)
1995	2	pesticides (1)
1992	1	nitrate
don't know when	5	hard (1)
never tested	9	other (1)

Six 1997 respondents reported a potential source for water pollution on their farm/ranch. These potential sources included: chemicals (1), pesticides (1), oil and gas wells (3), and manure runoff (1). Also, fourteen 1997 respondents reported potential sources for water pollution in their area including: oil and gas wells (7), fertilizers and pesticides (4), gypsum (1), animal waste (1), silt (1), and local lake (1). When asked to identify significant agricultural sources of water pollution in their area, two 1997 respondents reported sources: one respondent said "chemicals and fertilizers", and the other respondent said "floods". On the 1997 question asking respondents to identify a specific site in their area where water pollution is occurring, only one respondent identified a site and they said "oil site".

In the 1997 survey, 9 respondents described the BMPs they were using. The described BMPs include the following: terraces and waterways (5), grass planting (2), minimum tillage (1), soil management (1), fertilizer management (1), and "leave residue" (1). Nine respondents also reported having NRCS contracts in 1997: 2 of these respondents contracts were for terraces; 2 were for CRP; and 4 were for unspecified farm programs.

T-test results for the 5-level Likert type scale statements used on the 1994 and 1997 surveys are shown in Table III. It should be noted that respondents in 1994 agreed that farm operators' use of BMPs could best control water pollution while in 1997 respondents felt significantly different about this statement, feeling neutral about the statement. In addition, respondents in 1997 also moved significantly in attitude as compared to their 1994 counterparts on the statement that they "are more concerned about water quality now than I was five years ago": the 1997 respondents felt neutral

about the statement as compared to the 1994 respondents, who agreed with the statement. There were no significant changes in attitude in the 1997 respondents as compared to the 1994 respondents on any of the other attitudes measured in Table III. Respondents did appear to have a change in attitude, though not a significant change, on the following: "Farm Practices that protect water quality usually require more labor" was neutral in 1994 versus agree in 1997; "Agricultural water pollution is a serious threat to fish and wildlife" was neutral in 1994 versus disagree in 1997; "If farm operators don't do more to protect water quality on their own, the government will force them to through regulation" was agree in 1994 versus neutral in 1997; and "Fertilizers can be harmful to water quality" was agree in 1994 versus neutral in 1997.

TABLE III. Respondents' Attitudes Concerning Water Quality Statements (1-1.49=strongly agree; 1.5-2.49=agree; 2.5-3.49=neutral; 3.5-4.49=disagree; and 4.5-5=stongly disagree)

Statement	1994 response	1997 response	94 vs. 97 p-value
--Farm practices that protect water quality usually require more labor.	2.71	2.48	0.2317
--Agricultural water pollution is a serious threat to fish and wildlife.	3.18	3.52	0.1614
--Agriculture is being unfairly blamed as a cause of water quality problems.	2.47	2.19	0.2022
--If farm operators don't do more to protect water quality on their own, the government will force them to through regulation.	2.24	2.70	0.0582
--The government should help pay for water pollution control on farms.	2.82	2.63	0.2996
--Farm operators have the right to farm in any way they choose, even in ways that damage water quality.	4.06	3.81	0.1840
--Land owners have a responsibility to farm in ways that protect water quality.	1.76	2.15	0.0553

TABLE III CONTINUED

Statement	1994 response	1997 response	94 vs. 97 p-value
--Water pollution can be best controlled through farm operators' use of BMPs.	2.29	2.73	0.0436*
--Pesticides can be harmful to water quality.	2.29	2.16	0.3222
--Fertilizers can be harmful to water quality.	2.41	2.52	0.3631
--Pesticides have more potential for harm to water quality than fertilizers.	2.47	2.44	0.4590
--I am more concerned about water quality now than I was five years ago.	2	2.81	0.0021*

*significant at alpha 0.05

Table IV reports how the respondents rated water quality using a four point Likert type scale on their farm and in their area. Respondents in 1997 rated their overall area water quality significantly higher than the respondents did in 1994. The 1997 respondents rated their water quality as being "not a problem" as compared to the respondents of 1994 who said that their water quality had a "slight problem".

TABLE IV. Respondents Water Quality Rating for Their Farm and Area (1-1.49 = not a problem; 1.5-2.49 = slight problem; 2.5-3.49 = moderate problem; and 3.5-4.0 = serious problem)

Question	1994 response	1997 response	94 vs. 97 p-value
--How would you rate water quality on your farm?	1.39	1.19	0.2106
--How would you rate current overall water quality in your area?	2	1.31	0.0112*

*significant at alpha 0.05

In 1997 the respondents, when asked to indicate how often they had their soil tested, responded in the following manner: 8 said every year, 2 said every two years, 2

said every three years, 3 said every five years, 1 said greater than every 5 years, and 6 said that they never had their soil tested. One respondent in 1997 said they had their soil tested "often" and one said that they had their soil tested "seldom". When the 1997 respondents were asked whether they followed the recommendations from soil tests they answered in the following manner: 8 said that "yes" they did follow the recommendations; 9 said that they followed the recommendations "partially"; and 2 said that they did not follow the recommendation from soil tests. In 1994 only those respondents in the four watersheds who indicated that they were primarily crop producers were asked how often they soil tested. Of the 1994 primarily crop producing respondents in the four watersheds, 16 indicated soil testing every year; 9 indicated soil testing every two years; 17 indicated soil testing every three or more years; and 3 indicated that they never have their soil tested. The primarily livestock producers in 1994 were not asked to respond to the soil test question.

CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

All of the 1997 respondents had multiple agricultural sources that made up their total farming income. So, it could be potentially detrimental to a water quality educational program to target these respondents based on just their primary crop produced. Rather, some educational strategy that takes into consideration multiple types of production would be more effective. Farm process improvement strategies like participatory assistance (Lanyon, 1994), instead of just technology transfer, may be more successful with "mixed product" producers in effectively protecting water quality.

There is still an incredibly high use of streams as livestock watering sources among Barnitz Creek Watershed respondents in 1997, even though BMPs recommend eliminating livestock use of such sources in order to protect water quality. Also, almost all of the respondents raising livestock in Barnitz Creek still allow free access to streams and ponds for livestock watering even after BMPs recommending the use of "floating fences" on ponds and fencing-off of streams to exclude livestock and protect riparian areas have been developed. If it is really the desire of state and federal agencies to change producer practices, especially in riparian and stream bank management, then there seems to be a large failure in the educational and/or incentive effort in this area with these respondents. It is suggested that the method of delivery be closely scrutinized and that agricultural producers, themselves, be involved in development and implementation of any future strategies.

Some Barnitz Creek respondents are concerned about manure disposal. Few of the respondents seem impacted by CAFO regulations, though, and those that feel they are impacted have found creative ways to manage their livestock so as not to fall under CAFO regulations. There are many among the respondents in 1997 who do think CAFO regulations have value to the environment.

A few respondents reported having a problem with their drinking water. The two respondents with drinking water problems that could cause health related effects both had their drinking water tested within the last 5 years. Since over half of our respondents more than likely have not had their drinking water tested in the last five years and a large percentage of respondents use well water, it is recommended that the other respondents and residents of Barnitz Creek Watershed have their drinking water tested as nitrate and

other contamination are not necessarily indicated by water taste problems. It is further recommended that the Oklahom*A*Syst program, which is currently very active in Oklahoma, conduct a water testing day in the Barnitz Creek Watershed.

Oil and gas wells are a main potential water pollution source in the minds of Barnitz Creek respondents. The more visual nature of oil and gas pollution may come into play here. It is recommended that the NRCS and the Extension Service in Custer County conduct social events that encourage agricultural producers and those in the oil/gas industry to meet on a neutral ground. From this initial social meeting, perhaps a group of interested agricultural producers and oil/gas industry personnel could form a cooperative local board to voice, discuss and develop action plans on pertinent concerns that exist.

A similar number of respondents reported using BMPs as reported having NRCS contracts. However, most of the respondents who reported using BMPs did not have NRCS contracts. It is possible and likely that these respondents had some type of contract in the past. Most respondents that did not have current contracts, but did report use of BMPs, reported the BMPs of "terraces and waterways" which are classic contract BMPs. So, it is concluded that most of these respondents would not use BMPs if the financial incentive to do so were not included or available. There seems to be at the most one respondent whom identified BMPs that they may have adopted on their own. Some qualitative interviewing of respondents is suggested to further flesh out use and attitudes on BMPs.

The 1997 respondents' water quality attitudes as compared to the 1994 respondents' attitudes are moving in a direction contrary to what seems the state and

federal agencies desire. Again, there seems to be a failure in the programs and/or strategies used to influence attitudes among these respondents. There may have also been a decrease in emphasis in the Barnitz Creek Watershed on water quality related projects because of the conclusion of the EPA 319 grant that funded the interim water quality projects. Nevertheless, close scrutiny is recommended on past and current strategies used to evoke change in water quality related attitudes. If the 1994 survey can be used as an effective baseline against which to measure change, the 1997 survey suggests that water quality efforts made in Barnitz Creek may have actually influenced respondents in the opposite direction than was intended. The authors do recognize, though, that there are many other influences that can affect attitude.

Respondents feel that their water quality has improved as compared to the 1994 respondents. It is suggested that the earlier recommendation, on Oklahom*A*Syst performing water testing in Custer County and specifically Barnitz Creek Watershed, be used to see if there is a trend showing water quality improvement or not.

Soil testing among the 1997 respondents as with the 1994 respondents still seems to be a varied process with several in 1997 not having their soil tested at regular intervals. Perhaps an NRCS program, like has happened in LeFlore County, Oklahoma, could be conducted in Custer County/Barnitz Creek. The NRCS program suggested would involve the local NRCS Conservationist going out to each individual producer and conducting a free soil test on their property. The NRCS could then coordinate with the local Extension Agent to provide follow-up on aiding producers in following the soil test recommendations.

An overall recommendation as a result of this study would be for agency and university researchers to conduct more longitudinal analyses, especially in agriculture practices and attitudes related to water/environmental quality issues. It seems that there are many one time studies being performed without any kind of follow-up at regular intervals. Researchers should remain mindful of what studies have been performed in the past and the need for further research that seeks to measure change over time. There are multitudes of good baseline studies that have as their recommendations the need for further study. If measure of change and effects of educational endeavors is important, then past research is invaluable as a source for future research studies and accountability of educational programs.

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CHAPTER IV

AN EVALUATION OF A WATER QUALITY EDUCATIONAL PROGRAM IN A SMALL SOUTHEASTERN OKLAHOMA WATERSHED

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INTRODUCTION AND THEORETICAL FRAMEWORK

In areas of the United States where large scale animal production facilities are located and being planned for expansion, many potential benefits and problems are perceived by those involved with and/or impacted by these types of production. Confined animal production makes the news in many areas, especially when water quality is a local concern.

In Eastern Oklahoma, the poultry industry has received much media attention, mainly targeting the poultry industry's potential impact on the environment and especially on local water quality. The Tulsa World newspaper reported on its May 4, 1997 front page that animal waste "is a 'serious threat' to lakes and streams state-wide" in Oklahoma ("A red light for green country", 1997). The newspaper specifically stated that Lake

Wister, in Leflore County Oklahoma, had serious enough problems related to animal waste that officials were considering building a new drinking-water supply.

Animal waste, though, does not necessarily have to be a water quality problem if the management practices designed to protect water quality are implemented and properly followed (Chapman, 1996). Specific Best Management Practices (BMPs) for poultry litter/waste have been developed as well as many BMPs for agriculture land usage to limit impact to water quality (Chapman et al., 1992). BMPs, however, are often new ideas to agricultural producers and adoption of new practices is not necessarily an expedient process because of several reasons mainly tied to economics, information and persuasion (Cooper and Keim, 1996; Feather and Amacher, 1994; Nowak, 1992)

Farmers can think that there are problems that need to be addressed concerning things like water quality, but do not believe the problems occur on their own farm or in their area (Key and Pierce, 1996; Lichtenberg and Lessley, 1992). Interestingly, though, farmers can also believe that they do contribute to the problem (Halstead et al., 1990). Within these seemingly conflicting notions there must be some common ground that leads to both the assumption that the individual farmer does not impact the local water quality and that they do impact it. Extension water quality educational programming seeks to help farmers determine what common ground exists. This programming also seeks to help farmers think holistically, i.e. "we all live downstream", so that farmers realize that in some ways agriculture does impact water quality and in some ways it does not. It is important, then, to determine if Extension water quality educational programming achieves this realization among its targeted agricultural producers.

PURPOSES AND OBJECTIVES

The purposes of this study were to determine if any differences existed over time among agricultural producers who were targeted by water quality educational programs and if any differences existed between agricultural producers in two geographic areas, one which received water quality educational emphasis and one which did not. Specific objectives of the study were as follows:

1) to determine any difference in producers' attitudes, knowledge and practices between watersheds, one which received water quality educational emphasis and one that did not; and

2) to determine any change over time in producers' attitudes, knowledge and practices concerning water quality within Haw Creek Watershed.

METHODS AND PROCEDURES

The Haw Creek watershed is located in Southeast Oklahoma within Leflore County. It is an Environmental Protection Agency 319 project identified watershed having potential nonpoint sources of water pollution. Haw Creek Watershed has been targeted for extensive water quality educational programming by the Extension Service and the Natural Resources Conservation Service (NRCS). Much of the educational emphasis has been aimed at the growing poultry industry in LeFlore County and adoption of Best Management Practices (BMPs) to protect water quality in the area.

In 1995, the Landuser/Producer Survey of the Poteau River project was administered by the NRCS. The 1995 survey was developed by the NRCS representative in LeFlore County in cooperation with the Water Quality Extension Agent in Leflore County and was approved by the Lake Wister/Poteau River Advisory Committee. Most of the 1995 survey's questions were specifically targeted at poultry producers. The survey questions were "fill in the blank" and "circle answer" types. The population for the survey was all of the agricultural producers within the Black Fork Creek Watershed. The Black Fork Creek watershed contains the smaller Haw Creek Watershed. The results of this 1995 survey were reported by Kafidi (1997).

During the summer of 1997 the Haw Creek Agricultural Producer Survey was conducted by the LeFlore County Water Quality Extension Agent. The agent went to the residence of those being surveyed and completed the survey with the individual producers. The 1997 survey was developed by the State Extension Evaluation Specialist, the State Water Quality Specialist, the Experiment Station Research Associate, the Leflore County Water Quality Agent, and the Leflore County NRCS Conservationist and was approved by the Lake Wister/Poteau River Advisory Committee. Questions of interest from the 1995 survey were included in the 1997 survey for longitudinal study. The 1997 survey was reviewed by a panel of experts. The 1997 survey had specific sections targeted at poultry producers and livestock producers. The survey also had a water quality attitude portion consisting of eleven 5-point Likert type scale statements, which all producers answered. The population for the 1997 survey were the 18 agricultural producers within the Haw Creek Watershed. Of these 18 producers, 17 made up the population of agricultural producers in the Haw Creek Watershed in 1995. All 17

of the 1995 population were surveyed in the 1995 Blackfork Creek survey. The population of producers' responses in 1997 were compared to the population of producers' responses in 1995 for analysis purposes. The entire population of agricultural producers in Haw Creek Watershed was surveyed, then, in 1995 and 1997.

One of the purposes of the 1997 survey was to also compare the responses of producers within Haw Creek Watershed with responses of producers in a similarly sized geographical region that did not receive water quality educational emphasis. The area chosen for comparison with Haw Creek Watershed was the south-central portion of Township 9N, Range 25E near Spiro (Spiro), Oklahoma within Leflore County. This area was identified by the Leflore County Water Quality Extension Agent and NRCS Conservationist as an area which was similar to the Haw Creek Watershed, but had not received targeted water quality educational programs. The population of active agricultural producers of south-central Spiro Township was 17. All 17 of these producers were surveyed. The Water Quality Extension Agent delivered the survey in the same manner as delivered in the Haw Creek Watershed. The 17 producers from the Spiro area were compared to the 18 producers from the Haw Creek Watershed on the Haw Creek Watershed 1997 Survey.

The Excel spreadsheet program was used for analysis purposes.

RESULTS

Geographic Region Analysis

Basic demographic information can be seen in Table I. As can be seen from the table, producers from both Haw Creek Watershed (Haw) and Spiro farm a similar amount of acreage (except for one farmer in Spiro who farms 2,300 acres) and have similar amounts of farming income coming from cattle and poultry (Haw being slightly higher in both). All but one poultry producer in both Haw and Spiro, respectively, reported also producing cattle (not shown in Table I). Spiro had one producer who gained all of their farming income from hay production while Haw had 3 producers who gained 10 percent of their farming income from hay. No producers in Spiro gained any farming income from forestry, but 3 producers in Haw did for an average of 16.7 percent of farming income from forestry. One producer in Haw gained 10 percent of their farming income from "sheep dogs" and 3 producers within Spiro gained an average of 65 percent of their farming income from either dairy, row crops, or leases. A similar amount, about half, of total household income came from farming income for producers in both Haw and Spiro.

TABLE I. SELECTED DEMOGRAPHICS OF PRODUCERS IN HAW AND SPIRO

Demographic	# of producers	average	range
-Acres farmed:			
Haw	18	172.3	5-760
Spiro	16	197.4	20-600
-Percentage of farming income from cattle:			
Haw	15	72	10-100
Spiro	13	65.8	10-100

TABLE I. Continued

Demographic	# of producers	average	range
-Percentage of farming income from poultry:			
Haw	7	75.7	50-100
Spiro	8	68.8	30-100
-Percentage of farming income from hay:			
Haw	3	10	10
Spiro	1	100	100
-Percentage of farming income from forestry:			
Haw	3	16.7	10-20
Spiro	0		
-Percentage of farming income from "other" sources:			
Haw (sheep dogs)	1	10	10
Spiro (dairy, crops, leases)	3	65	45-100
-Percent of total household income from farming income:			
Haw	18	49.8	2-100
Spiro	17	48.4	1-100

It is interesting to note the difference in drinking water source between Haw and Spiro as seen in Table II. All Haw producers received their drinking water from private wells while Spiro producers received their drinking water primarily from rural water sources.

TABLE II. PRODUCERS' HOUSEHOLD DRINKING WATER SOURCE

Area	private well	rural	well and rural
Haw	18	0	0
Spiro	4	10	3

On the livestock producer portion of the 1997 Haw Creek Agricultural Producer Survey, the results in Table III were found. The total number of mature cattle per producer in Haw was between 26-50 head and in Spiro it was between 51-75 head. All livestock producers in Haw and Spiro used ponds as a drinking water source for their livestock. A larger number of livestock producers in Haw used streams as a source for livestock watering as compared to Spiro. Over half of the livestock producers in Haw used a combination of pond watering with well and/or streams while in Spiro a little less than a third used a combination of watering sources for their livestock. More livestock producers in Spiro used ponds as their sole livestock watering source as compared to Haw. More producers in Haw had streams flowing through their pasture. A higher percentage of livestock producers in Spiro with streams flowing through their pastures reported having a streambank management strategy in place. A lower percentage of producers in Haw allow their livestock free access to streams and/or ponds as compared to Spiro. The livestock producers in Haw use more rotational and less continuous grazing as compared to Spiro. On weed control, livestock producers in Haw use less weed control; less reliance on weed spraying as a sole control; less mowing; and more use of a combination of mowing and spraying. All livestock producers who do spray as a form of weed control use 2,4-D for this purpose.

TABLE III. LIVESTOCK PRODUCER RESPONSES TO LIVESTOCK SECTION

Question	# of producers	average or %	range
-What is your approximate number of mature cattle?			
Haw	17	26-50 head	1-25 to 201-225
Spiro	14	51-75 head	1-25 to 275-300
-What is the source of water for your livestock?			
Haw			
pond	8	47.1%	
pond & stream	6	35.3%	
pond & well	2	11.8%	
pond, stream & well	1	5.9%	
Spiro			
pond	10	71.4%	
pond & stream	3	21.4%	
pond & well	1	7.1%	
-Do you have any streams running through your pastures?			
Haw (yes)	13	76.5%	
Spiro (yes)	8	57.1%	
-If you do have streams, do they flow year round?			
Haw (yes)	8	61.5%	
Spiro (yes)	4	50%	
-If you do have streams, do you have a controlled riparian streambank area or a buffer strip?			
Haw (yes)			
riparian area	3	23.1%	
buffer strip	2	15.4%	
Spiro (yes)			
riparian area	0	0	
buffer strip	4	50%	
-Do your livestock have free access to streams and/or ponds?			
Haw (yes)	13	76.5%	
Spiro (yes)	14	100%	

TABLE III. Continued

Question	# of producers	average or %	range
-What type of grazing system do you use?			
Haw			
continuous	6	35.3%	
rotational	10	58.8%	
continuous & rotational	1	5.9%	
Spiro			
continuous	9	64.3%	
rotational	4	28.6%	
rotational & short duration	1	7.1%	
-Do you practice weed control?			
Haw (yes)	12	70.6%	
Spiro (yes)	12	85.7%	
-If you do practice weed control, do you mow or spray?			
Haw			
mow	5	41.7%	
spray	2	16.7%	
mow and spray	5	41.7%	
Spiro			
mow	8	66.7%	
spray	3	25%	
mow and spray	1	8.3%	
-If you spray, what do you use?			
Haw (2,4-D)	7	100%	
Spiro (2,4-D)	4	100%	

In Table IV it can be seen that poultry producers in Spiro had mainly 25,000 bird capacity houses while poultry producers in Haw had mainly 20,000 bird capacity houses. This difference is a result of newer poultry houses in Spiro. Most poultry producers in Haw had 2 poultry houses, but most poultry producers in Spiro had more than two houses. Almost twice as many birds are produced annually in Spiro as compared to Haw.

TABLE IV. POULTRY HOUSE DEMOGRAPHICS OF POULTRY PRODUCERS

Question	Number
-How many poultry houses do you have?	
Haw	
two 20,000 bird capacity houses	5
two 25,000 bird capacity houses	1
four 20,000 bird capacity houses	1
Total birds produced annually in Haw	**1,690,000**
Spiro	
two 25,000 bird capacity houses	3
three 25,000 bird capacity houses	2
four 22,500 bird capacity houses	1
four 25,000 bird capacity houses	2
Total birds produced annually in Spiro	**2,950,000**

Poultry producers in Haw compared to producers in Spiro, as can be seen in Table V, clean cake less often and are more concerned about litter disposal. More poultry producers in Haw have their poultry litter nutrient tested and have facilities to store poultry litter. A similar number of producers in both Haw and Spiro have Waste Utilization plans (basically, all of them).

TABLE V. POULTRY PRODUCER PRACTICES AND LITTER CONCERN

Practice/Concern	Producers answering "yes"	% poultry producers
-Do you clean cake after each batch of chickens?		
Haw	5	71.4
Spiro	8	100
-Do you test your litter for nutrient content?		
Haw	2	28.6
Spiro	1	12.5

TABLE V. Continued

Practice/Concern	Producers answering "yes"	% poultry producers
-Do you currently have facilities to store poultry litter on your farm?		
Haw	3	42.9
Spiro	2	25
-Do you have an NRCS, Conservation District Waste Utilization Plan?		
Haw	7	100
Spiro	7 (1 don't know)	87.5-100
-Are you concerned about litter disposal?		
Haw	6	85.7
Spiro	3	37.5

On litter usage, a slightly smaller percentage of individual producers' litter was used in Haw as fertilizer on the producers' owned land as compared to Spiro as can be seen in Table VI. What was important to note here, though, is that close to twice as much litter is being generated in Spiro as compared to Haw based on poultry production totals in each area. Of the poultry producers who sold their litter as fertilizer, a lower percentage was sold in this way in Haw as compared to Spiro. A result that is not in the table and does not make sense is that Spiro producers reported a litter application rate on average of 1.8 tons per acre while Haw producers reported an average application rate of 2.6 tons per acre. Now, both of these results are within the recommended BMP of 3 tons per acre, but the Spiro result does not make sense. The question should be raised in Spiro of where all of the rest of the litter is going or maybe producers really don't know what their true application rate is on their land. With twice as many birds, similar sized farms, and a similar percentage being applied in each geographic area the reported application rates are at best confusing.

TABLE VI. POULTRY PRODUCER LITTER USE ESTIMATES

How litter was used	# producers	average % litter used
-Utilized as fertilizer on producers' owned land:		
Haw	7	62.9
Spiro	8	69.4
-Litter utilized as cattle feed for producer's own cattle:		
Haw	5	15
Spiro	1	15
-Litter sold by poultry producer as fertilizer:		
Haw	3	61.7
Spiro	3	76.7

More poultry producers in Spiro cleaned out their poultry houses by themselves as compared to Haw (Table VII). A similar number of poultry producers only used contractors to clean out their poultry houses in both Haw and Spiro. Over a quarter of the producers in Haw used a combination of cleaning their houses themselves and having a contractor clean them sometimes too; no poultry producers in Spiro used this combination.

TABLE VII. WHO CLEANS OUT PRODUCERS' POULTRY HOUSES

Person Cleaning Houses	# of producers
Self	
Haw	1
Spiro	4
Contractor	
Haw	4
Spiro	4
Self & Contractor	
Haw	2
Spiro	0

Haw poultry producers used a wider variety of disposal methods for their dead chickens as compared to Spiro (Table VIII). It is important to notice that one producer in Haw still buries his chickens and one producer in Spiro would not describe his exact disposal method.

TABLE VIII. HOW POULTRY PRODUCERS DISPOSE OF DEAD CHICKENS

Area	composter	freezer	burn	bury	render	other
Haw	3	1	0	1	2	0
Spiro	5	0	2	0	0	1

In Table IX it can be seen that nearly all producers in Haw have Conservation Plans while only less than a third have them in Spiro. Some producers in Haw do think that agriculture is a significant cause of water pollution in their area compared to no producers thinking this is true in Spiro. Several more producers in Haw versus Spiro had their household water tested in the last two years. Over 80 percent of producers in Haw had their soil tested within the last two years while only 1 producer in Spiro had done so. A 13 percent lower number of producers in Haw reported having active erosion occurring on their pastures as compared to Spiro. All producers in Spiro reported that their septic systems met Oklahoma Health Department criteria, but two producers in Haw reported their septic systems did not meet the criteria.

TABLE IX. RESPONSES ON PRODUCERS' PRACTICES AND BELIEFS

Question	# producers answering "Yes"
-Do you have a Conservation Plan with the Leflore County Conservation District?	
Haw	15
Spiro	5
-Do you think agriculture is a significant cause of water pollution in your area?	
Haw	3
Spiro	0
-Has your household water been tested in the past 2 years? (only well water respondents)	
Haw	5
Spiro	1
-Have you had your soil tested within the last two years?	
Haw	15
Spiro	1
-Do you have active erosion occurring on your pastures?	
Haw	4
Spiro	6
-Does your septic system meet Oklahoma Health Department criteria?	
Haw	16
Spiro	17

Producers in Haw were more likely to rate the overall water quality in their area as a "moderate" or "serious" problem" as compared to Spiro (Table X). Both Haw and Spiro producers thought on average that their was a "slight problem" with their overall water quality in their area; Haw producers thought their was a slight problem more strongly than Spiro producers. Also, both Haw and Spiro producers thought their water in their area was "about the same" as it was ten years ago. Haw producers were much more likely to report that there was some type of water quality problem on their farm/ranch as compared to Spiro producers. The Haw producers felt on average that

there was a slight problem to not a problem with their water quality on their farm/ranch while the producers in Spiro felt on average solidly that there was no water quality problems on their farm/ranch. Producers in Haw disagreed with producers in Spiro on their rating of the water quality in Lake Wister, the local lake that receives the drainage from Haw Creek and is the drinking water source for rural water users in Spiro. Producers in Haw thought the Lake Wister water quality was "bad" while the producers in Spiro thought the water quality to be "good".

TABLE X. PRODUCERS' WATER QUALITY RATINGS

Question	Haw	Spiro
-How would you rate current overall water quality in your area?		
serious problem	2	0
moderate problem	5	2
slight problem	5	8
not a problem	5	6
don't know	1	1
overall rating	**slight problem**	**slight problem**
-Compared to ten years ago, do you think water quality in your area is:		
better	3	1
about the same	11	14
worse	4	1
don't know	0	1
overall rating	**about the same**	**about the same**
-How would you rate water quality on your farm/ranch?		
serious problem	0	0
moderate problem	1	0
slight problem	7	3
not a problem	10	14
overall rating	**slight problem/not a problem**	**not a problem**
-How would you rate the water quality of Lake Wister?		
very good	0	1
good	3	11
bad	11	3
very bad	2	0
don't know	2	2
overall rating	**bad**	**good**

Table XI shows that producers in Haw reported using more BMPs than producers in Spiro. However, it does appear based on the number of streams running through pastures in Haw that more riparian area BMPs could be implemented.

TABLE XI. PRODUCERS' INDICATING USE OF BMPS IN SELECTED AREAS

Farm area	Haw	Spiro
animal waste	13	7
pasture	9	6
riparian areas	5	6

On average, producers in Haw thought more so than those in Spiro that farm practices that protect water quality require more labor and financial investment; agricultural water pollution is a serious threat to fish and wildlife; if farm operators don't do more to protect water quality on their own, the government will force them to through regulation; the government should help pay for water pollution control on farms; water pollution can best be controlled through farm operators' use of BMPs; commercial fertilizer is less of a water quality problem than poultry litter; they are more concerned about water quality now than they were 5 years ago; and nonpoint source pollution is a more serious threat to water quality than point source pollution (Table XII). And, on average, producers in Spiro thought more so than those in Haw that agriculture is being unfairly blamed as a cause of water quality problems and farm operators have the right to farm in any way they choose, even in ways that damage water quality.

TABLE XII. Respondents' Attitudes Concerning Water Quality Statements (1-1.49=strongly agree; 1.5-2.49=agree; 2.5-3.49=neutral; 3.5-4.49=disagree; and 4.5-5=stongly disagree)

Statement	mean response #	mean agreement response
--Farm practices that protect water quality usually require more labor.		
Haw	2.5	neutral
Spiro	2.69	neutral
--Farm practices that protect water quality usually require more financial investment.		
Haw	*2.11*	*agree*
Spiro	*2.44*	*agree*
--Agricultural water pollution is a serious threat to fish and wildlife.		
Haw	2.83	neutral
Spiro	3.13	neutral
--Agriculture is being unfairly blamed as a cause of water quality problems.		
Haw	3	neutral
Spiro	2.5	neutral
--If farm operators don't do more to protect water quality on their own, the government will force them to through regulation.		
Haw	2.11	agree
Spiro	2.44	agree
--The government should help pay for water pollution control on farms.		
Haw	2.56	neutral
Spiro	2.88	neutral
--Farm operators have the right to farm in any way they choose, even in ways that damage water quality.		
Haw	3.89	disagree
Spiro	3.81	disagree
--Water pollution can be best controlled through farm operators' use of BMPs.		
Haw	2	agree
Spiro	2.25	agree
--Commercial fertilizer is less of a water quality problem than poultry litter.		
Haw	3.22	neutral
Spiro	3.31	neutral
--I am more concerned about water quality now than I was five years ago.		
Haw	2	agree
Spiro	2.13	agree
--Nonpoint source pollution is a more serious threat to water quality than point source pollution.		
Haw	3.59	disagree
Spiro	3.75	disagree

Longitudinal Analysis

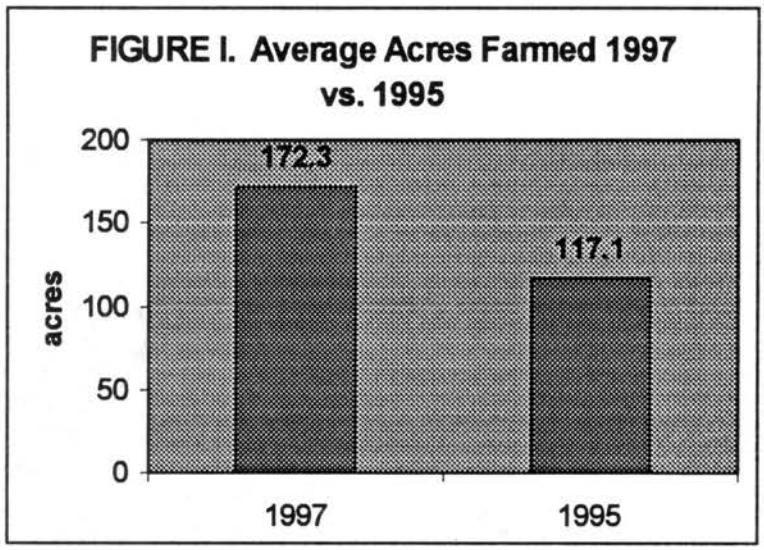
The longitudinal analysis of Haw was based on fewer questions than was the analysis between the Haw and Spiro regions. This analysis was limited by the questions originally asked on the 1995 NRCS survey. Nevertheless, 18 questions were asked on the 1997 survey that were asked on the 1995 survey and will be considered here.

In Table XIII it can be seen that there is a similar amount of livestock and poultry producers in Haw in both 1995 and 1997. Not in the table, but expected, is that all but one poultry producer in Haw in both 1995 and 1997, respectively, reported producing cattle also.

TABLE XIII. NUMBER OF PRODUCERS BY TYPE OF PRODUCTION

Product	# of producers
Livestock	
1995	14
1997	17
Poultry	
1995	8
1997	7

Average acres farmed per producer in Haw increased in 1997 versus 1995 (Figure I). An increase of 47.1 percent in average acres farmed was seen in 1997 over 1995.



The major changes in poultry house demographics can be seen in Table XIV. There was one less poultry producer in 1997 as compared to 1995, but a similar number of birds was still being produced in both years. In 1997 all poultry producers had at least two poultry houses with 20,000 bird capacities each and could produce at least 200,000 birds per year.

TABLE XIV. POULTRY HOUSE DEMOGRAPHICS 1995 VS 1997

Question	Number
-How many poultry houses do you have?	
Haw 1995	
one 20,000 bird capacity house	1
two 20,000 bird capacity houses	4
two 25,000 bird capacity houses	2
four 20,000 bird capacity houses	1
Total birds produced annually in Haw 1995	**1,800,000**
Haw 1997	
two 20,000 bird capacity houses	5
two 25,000 bird capacity houses	1
four 20,000 bird capacity houses	1
Total birds produced annually in Haw 1997	**1,690,000**

Almost triple the number of 1995 poultry producers cleaned cake after each batch of chickens in 1997 (Table XV). No poultry producers tested their litter for nutrient content or had facilities to store poultry litter in 1995, but some did adopt these practices by 1997. Nearly all producers had Waste Utilization Plans in 1995 and in 1997 they all had these plans. These Plans are now required for most of these poultry producers by their contracting company.

TABLE XV. POULTRY PRODUCER PRACTICES 1995 VS 1997

Practice/Concern	Producers answering "yes"	% poultry producers
-Do you clean cake after each batch of chickens?		
Haw 1995	2	25
Haw 1997	5	71.4
-Do you test your litter for nutrient content?		
Haw 1995	0	0
Haw 1997	2	28.6
-Do you currently have facilities to store poultry litter on your farm?		
Haw 1995	0	0
Haw 1997	3	42.9
-Do you have an NRCS, Conservation District Waste Utilization Plan?		
Haw 1995	7	87.5
Haw 1997	7	100

A lot fewer poultry producers in 1997 cleaned out their poultry houses by themselves compared to producers in 1995(Table XVI). The same number of poultry producers used contractors exclusively to clean out their poultry houses in both 1995 and 1997. While no poultry producers used both themselves and contractors to clean out their poultry houses in 1995, two producers in 1997 adopted this poultry house cleaning method.

TABLE XVI. WHO CLEANS OUT PRODUCERS' POULTRY HOUSES 1995 VS 1997

Person Cleaning Houses	# of producers
Self	
Haw 1995	4
Haw 1997	1
Contractor	
Haw 1995	4
Haw 1997	4
Self & Contractor	
Haw 1995	0
Haw 1997	2

On the 1995 survey poultry producers were asked to report how they disposed of their dead chickens and were given the following three choices: composter, burn, and other. On the 1997 survey poultry producers were given the choices of composter, freezer, burn, bury, render and other to answer the disposal question. The poultry producers in 1995 all said that they used "other" methods to dispose of their dead chickens. Noteworthy among poultry producers in 1997 was the adoption by several producers of the use of composters to dispose of their dead chickens.

TABLE XVII. POULTRY PRODUCERS' DISPOSAL OF DEAD CHICKENS 1995 VS 1997

Area	composter	freezer	burn	bury	render	other
Haw 1995	0	NA	0	NA	NA	8
Haw 1997	3	1	0	1	2	0

Among livestock producers, over twice as many by percentage (64.7 percent versus 30.8 percent) incorporated rotational grazing into their grazing system in 1997 versus 1995 (Table XVIII). Fewer livestock producers in 1997 practiced weed control than in 1995. Livestock producers in both 1995 and 1997 used 2,4-D as their spray of choice in controlling weeds.

TABLE XVIII. LIVESTOCK PRODUCER RESPONSES 1995 VS 1997

Question	yes responses
-What type of grazing system do you use?	
Haw 1995	
continuous	9
rotational	4
Haw 1997	
continuous	6
rotational	10
continuous & rotational	1
-Do you practice weed control?	
Haw 1995	14
Haw 1997	12
-If you do practice weed control, do you mow or spray?	
Haw 1995	
mow	7
spray	1
mow and spray	6
Haw 1997	
mow	5
spray	2
mow and spray	5
-If you spray, what do you use?	
Haw 1995 (2,4-D)	6
no answer	1
Haw 1997 (2,4-D)	7

As can be seen in Table XIX, a few more 1997 agricultural producers as compared to 1995 producers in Haw had Conservation Plans and reported that their septic systems met Health Department criteria. Several more 1997 producers reported having active erosion occurring on their pastures as compared to producers in 1995. Very noticeable, nearly all the producers in 1997 had their soil tested within the last two years while only one producer had done so in 1995.

TABLE XIX. AGRICULTURAL PRODUCERS' PRACTICES AND BELIEFS 1995 VS 1997

Question	# producers answering "Yes"
-Do you have a Conservation Plan with the Leflore County Conservation District?	
Haw 1995	12
Haw 1997	15
-Has your household water been tested in the past 2 years? (all producers use well water)	
Haw 1995	4
Haw 1997	5
-Have you had your soil tested within the last two years?	
Haw 1995	1
Haw 1997	15
-Do you have active erosion occurring on your pastures?	
Haw 1995	1
Haw 1997	4
-Does your septic system meet Oklahoma Health Department criteria?	
Haw 1995	13
Haw 1997	16

CONCLUSIONS

Farming income within Haw Creek Watershed is very important to its resident agricultural producers making up about half of their total income and tying them intimately to the land and water that this production relies upon. Haw Creek's agricultural producers can be directly affected through their household drinking water source, private well water, by any contaminants, agricultural or other, that can percolate down into their groundwater. Also, in a similar way their livestock can be affected by any changes in the surface water that may occur. So, Haw Creek farmers/ranchers rely on the land and water for their livelihood and can be directly affected in their drinking water by their choices in production practices and methodologies. Being within an easily conceptualized circle of production and effects of production, it would seem that the Haw Creek producers, when presented with knowledge that would protect them and their livelihood, would adopt practices that were presented to them in various educational programs that were available within their area. This also assumes that the educational programs fit the needs of the producers and were interesting and well advertised. It does seem quite obvious upon analysis that there have been changes within Haw Creek Watershed's agricultural producers over time for the betterment of water quality and that these changes were also the thrust of the educational programming within the watershed.

Haw Creek producers used more BMPs as compared to producers in Spiro. There is still, however, plenty of room for continued improvement. It is suggested that educational programs continue, especially individual farmer contact and on-farm management planning, in the areas of grazing systems, riparian area management,

limiting cattle free access to ponds/streams, poultry litter management, and drinking water testing.

Haw Creek producers were more concerned about their water quality than producers in Spiro and were more likely to think of themselves and/or agriculture as partially to blame for water quality problems. This seems to indicate that producers in Haw were more holistic in their thinking about the various possible causes of detriment to water quality.

Agricultural producers within Haw Creek thought more strongly than Spiro producers that more labor and financial investment was required to protect water quality. This may come from the increased emphasis and actual implementation of water quality protection strategies among the producers in Haw. Even though the Haw producers may recognize the significance of changing practices, they still are more concerned than in Spiro about how hard it will be to change and how much it might cost them. They also agree more than in Spiro that the government should help pay for water pollution control on their farms.

The positive differences among producers in Haw Creek are very pronounced over time. Even with the limited number of questions used longitudinally, it can be easily seen that while types of production are basically the same, even with an increased use of land, many practices have changed for the better. Producers in 1997 used more BMPs than they did in 1995 and seemed more likely to report problems on their own farms (i.e. erosion). It should be suggested as it was earlier that more water testing should be emphasized perhaps through the Oklahom*A*Syst program. Also, weed

control by use of spraying should receive some attention to determine if any water quality impacts are occurring as a result of continued spraying over time.

The water quality educational emphasis within Haw Creek Watershed seems easily described as "successful" in its relatively short 2 year existence in changing agricultural producers' practices and attitudes concerning water. It also seems that, at least in this case, hiring a LeFlore County Water Quality Extension Agent who was raised very close to the area was a positive influence to the success of this project. By having a common ground with the agricultural producers of the area, the Water Quality Extension Agent was able to get all producers to participate in the survey for two years and also between two geographic regions. It is suggested that in other counties where water quality education is needed, an Extension Agent be hired that can educatedly and diversely address agricultural education in water quality without alienating or succumbing to the intended audience.

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APPENDIXES

APPENDIX A

QUESTIONNAIRES

Water Quality Survey
(09/16/93)

Parucipant Name:_____

Phone Number:_____ Watershed:_____

Address:_____

Date Contacted:_____ Time:_____

Hello, may I speak with _____? Thank you. Hello, my name is _____ and I am with Oklahoma State University. We are conducting a survey concerning water quality in Southwest Oklahoma, and would like to ask you a few questions regarding your farming operation and your opinions concerning water quality. ***All responses are strictly confidential.***

Your cooperation in this survey is extremely important, and to show our appreciation we would like to send you a voucher for a free soil test and a brochure on Integrated Pest Management (IPM). Also, a summary of the information gained through this survey will be available to you if you would like a copy.

1. Do you have time to answer a few questions right now? Yes No

2. If not, is there a time when we can call back that would be more convenient? _____

   If not, thank you for your time.

I would like to start the survey by asking you a few questions related to your farming operation. Please feel free to ask me to repeat any question you do not understand. If you prefer not to answer a question, tell me and we'll go on to the next one.

3. How long have you been farming? _____years

I would like to ask you some questions about specific crops and livestock in your farming operation. What is your major crop?

4. _____ Alfalfa (Appendix I)
5. _____ Cotton (Appendix II)
6. _____ Peanuts (Appendix III)
7. _____ Wheat (Appendix IV)

8. Do you raise any livestock, and if so, how many? Yes No _____ (Appendix V)

9. How large is your total farming/ranching operation? _____ acres

(At this time, please complete the Appendix section related to the major crop grown by the participant)

(Complete this section only after the specific crop/livestock questions have been answered!)

10. How would you rate overall water quality in your area? *(Read choices)*
_____ Serious problem
_____ Moderate Problem
_____ Somewhat of a problem
_____ Not a problem
_____ Don't know

11. Compared to ten years ago, do you think water quality in your area is _____? *(Read choices)*
_____ Better
_____ About the same
_____ Worse
_____ Don't know

12. How much have you heard or read about how agriculture might affect water quality? *(Read choices)*
_____ A lot
_____ Some
_____ A little
_____ Nothing

13. What do you think are the major causes of water pollution in your area? *(Do not read choices)*
_____ Runoff from cropland
_____ Fertilizers (nutrients)
_____ Pesticides (insecticides/herbicides, fungicides)
_____ Livestock/Animal waste (manure)
_____ City or town sewer systems
_____ Waste Treatment Plants
_____ Household septic systems
_____ Runoff from urban or paved areas
_____ Industrial waste/Factory discharge
_____ Litter or garbage
_____ Landfills/Dumps
_____ Home and garden chemicals (insecticides, fertilizer)
_____ Oil Fields/Injection Wells
_____ County Roads
_____ Construction
_____ Other (specify)

14. How serious is water pollution on your farm? *(Read choices)*
_____ Serious problem
_____ Moderate problem
_____ Somewhat of a problem
_____ Not a problem
_____ Don't know

15. Where does runoff water from your farm go?

16. What is the source of your drinking water? *(Do not read choices)*
_____ Well
_____ Pond
_____ City Water
_____ Rural Water (source_____)
_____ Other (specify)

17. How concerned are you about pollution of your own drinking water? (*Read Choices*)
_____ Very concerned
_____ Somewhat concerned
_____ Not concerned
_____ Don't know

If *Very* or *Somewhat Concerned*, what is your major concern?
_____

18. How concerned are you about bacteria in your own drinking water? (*Read Choices*)
_____ Very concerned
_____ Somewhat concerned
_____ Not concerned
_____ Don't know

19. How concerned are you about pesticides in your own drinking water? (*Read Choices*)
_____ Very concerned
_____ Somewhat concerned
_____ Not concerned
_____ Don't know

20. How concerned are you about nitrates in your own drinking water? (*Read Choices*)
_____ Very concerned
_____ Somewhat concerned
_____ Not concerned
_____ Don't know

21. Where do you now get most of your information about water quality? (*Do not read choices*)
_____ Newspapers
_____ Farm Magazines (*Successful Farming, Farm Journal, Progressive Farmer*, etc.)
_____ Television
_____ Radio
_____ The Extension Service (meetings, workshops, tours, demonstrations)
_____ County Health Department
_____ The Soil Conservation Service (SCS)
_____ The Agricultural Stabilization and Conservation Service (ASCS)
_____ Farm Organizations (Cattleman's Association, Hay Growers' Association, etc.)
_____ Pesticide or Fertilizer Dealers
_____ Other (specify)

With regard to pesticides, please answer the following questions.

22. If you have MIXED pesticide products left, how do you dispose of them? *(Do not read choices)*
_____ Spray them on labeled site
_____ Pour/dump them out
_____ Keep them for next treatment
_____ Other (specify)

23. How do you dispose of old, unused pesticides? *(Do not read choices)*
_____ Pour them out
_____ Use them
_____ Take them back to the dealer
_____ Bury them
_____ Store them
_____ Other (specify)

24. When liquid pesticide containers are empty, do you triple or pressure rinse them before disposal? *(Do not read choices)*
_____ Yes
_____ No
_____ Sometimes

25. Where do you mix/load your pesticides? *(Do not read choices)*
_____ In the field
_____ Beside or within 50 feet of a well
_____ Beside other water source (pond, creek, etc.)
_____ Beside storage shed
_____ Other (specify)

26. Do you have a special pad to contain spills when mixing/loading pesticides?
_____ Yes
_____ No

27. Do you currently have any ASCS or SCS contracts, such as cost-share or incentive programs, for your farm? (*Do not read choices*)
_____ Yes
_____ No
_____ Don't know

28. Are you familiar with the term *Best Management Practices* (BMPs)? (*Do not read choices*)
_____ Yes
_____ No
_____ Somewhat

29. What do you believe is the number one pollution or environmental concern in Oklahoma?

For each of the following statements, please indicate the extent to which you agree or disagree with each of the following. 1 = Strongly Agree, 5 = Strongly Disagree.

Statement		Strongly Agree				Strongly Disagree
1.	Farm practices that protect water quality usually require more labor.	1	2	3	4	5
2.	Agricultural water pollution is a serious threat to fish and wildlife.	1	2	3	4	5
3.	Agriculture is being unfairly blamed as a cause of water quality problems.	1	2	3	4	5
4.	If farm operators don't do more to protect water quality on their own, the government will force them to, through regulation.	1	2	3	4	5
5.	The government should help pay for water pollution control on farms.	1	2	3	4	5
6.	Farm operators have the right to farm any way they choose, even in ways that damage water quality.	1	2	3	4	5
7.	Land owners have a responsibility to farm in ways that protect water quality.	1	2	3	4	5
8.	Water pollution can best be controlled through farm operators' use of BMPs.	1	2	3	4	5
9.	Pesticides are harmful to water quality.	1	2	3	4	5
10.	Fertilizers are harmful to water quality.	1	2	3	4	5
11.	Pesticides are more harmful to water quality than fertilizers.	1	2	3	4	5
12.	Most of the farmers in my area are very concerned about water quality.	1	2	3	4	5
13.	Waste disposal is a concern on many farms and ranches in my area.	1	2	3	4	5
14.	I am more concerned about water quality now than I was five years ago.	1	2	3	4	5

Is there anything else you would like to add regarding water quality, or is there a specific topic relating to water quality that you would like to receive more information about?

Thank you very much for your time. Your cooperation in projects such as this is vital for their success. The Extension Service and Oklahoma State University are working to serve you, and your opinions are extremely valuable in developing programs that meet your needs.

Would you be interested in receiving a summary of the results of this study? Yes No

Again, thank you for your time.

Appendix I --Alfalfa

Please answer the following questions regarding your alfalfa operation.

1. Number of Alfalfa Acres Grown _____

Please describe your alfalfa yields during the last ten years by answering the following questions.

2. Average Yield/Acre _____tons
3. Highest Yield/Acre _____tons
4. Lowest Yield/Acre _____tons

5. How often do you have your soil tested? Every _____ years _____Never

6. Do you follow the recommendations resulting from these soil tests? Yes No Partially

7. If not, how do you decide how much fertilizer to apply? *(Do not read choices)*

_____ Consultant's recommendations
_____ Fertilizer Dealer
_____ Doing what I have always done
_____ Read Extension Fact Sheets
_____ Other (specify)

8. What plant nutrients do you apply annually to your alfalfa crop? What is the rate of application? *(Do not read choices)*

Nutrient	Rate (Lbs/Acre)
_____ Nitrogen	_____
_____ Phosphate	_____
_____ Potash	_____
_____ Zinc	_____
_____ Magnesium	_____
_____ Sulphur	_____
_____ Gypsum	_____
_____ Lime	_____
_____ Micronutrients	_____
_____ Other (specify)	_____

Please answer the following questions regarding your primary alfalfa pest problems and the pesticides used to control them.

Insects (9)	Pesticide	Rate/Acre	Method of Application Ground/Air	Self/Commercial	Soil/Foliar
Weeds (10)					
Diseases (11)					

12. How do you decide when to apply pesticides? *(Do not read choices)*

_____ Scout fields
_____ Calendar
_____ Extension Agent
_____ Consultant
_____ Do what I have always done in the past
_____ Other (specify)

13. If you scout your fields, approximately how long does it take you (or your scouts) to scout 10 acres of alfalfa?

_____

Appendix II – Cotton

I'd like to ask you a few questions regarding your cotton operation.

1. Number of Cotton Acres Grown _____

Please describe your cotton yields during the last ten years by answering the following questions.

Dryland Cotton		Irrigated Cotton	
2. Average Yield/Acre	_____bales	5. Average Yield/Acre	_____bales
3. Highest Yield/Acre	_____bales	6. Highest Yield/Acre	_____bales
4. Lowest Yield/Acre	_____bales	7. Lowest Yield/Acre	_____bales

8. How often do you have your soil tested? Every _____ years _____Never

9. Do you follow the recommendations resulting from these soil tests? Yes No Partially

10. If not, how do you decide how much fertilizer to apply? *(Do not read choices)*

_____ Consultant's recommendations
_____ Fertilizer Dealer
_____ Doing what I have always done
_____ Read Extension Fact Sheets
_____ Other (specify)

11. What is your tillage system for your cotton? *(Do not reach choices)*

_____ Clean Till
_____ Ro-Till
_____ No-Till
_____ Minimum Till
_____ Stubblemulch
_____ Other (specify)

12. What plant nutrients do you apply annually to your cotton crop? What is the rate of application? *(Do not read choices)*

Nutrient	Rate (Lbs/Acre)
_____ Nitrogen	_____
_____ Phosphate	_____
_____ Potash	_____
_____ Zinc	_____
_____ Magnesium	_____
_____ Sulphur	_____
_____ Gypsum	_____
_____ Lime	_____
_____ Micronutrients	_____
_____ Other (specify)	_____

Please answer the following questions regarding your primary cotton pest problems and the pesticides used to control them.

Insects (13)	Pesticide	Rate/Acre	Method of Application Ground/Air	Self/Commercial	Soil/Foliar
Weeds (14)					
Diseases (15)					

16. How do you decide when to apply pesticides? *(Do not read choices)*
_____ Scout fields
_____ Calendar
_____ Extension Agent
_____ Consultant
_____ Do what I have always done in the past
_____ Other (specify)

17. If you scout your fields, approximately how long does it take you (or your scouts) to scout 10 acres of cotton?

_____

18. Do you rotate other crops with your cotton? *a. Dryland* Yes No *b. Irrigated* Yes No

19. If yes, describe your crop rotation schedule.
Dryland –

Irrigated –

20. Number of Cotton Acres Irrigated _____ *(If zero, skip to number 19)*

21. Where do you get your irrigation water? *(Do not read choices)*
_____ Well Water
_____ Stream
_____ Pond
_____ Altus Irrigation District
_____ Other (specify)

22. Do you have any problems with the quality of your irrigation water? *(Do not read choices)*
_____ No problems.
_____ Salt
_____ Low water table
_____ Weed seeds
_____ Other (specify)
_____ Do not irrigate

23. Do you use chemigation or fertigation?
_____ Yes
_____ No

24. If yes, what measures do you take to prevent backflow? How much did it cost to install?

25. How do you decide when to irrigate? *(Do not read choices)*
_____ Weather
_____ Condition of crop
_____ Soil moisture
_____ Calendar
_____ Feed/Fertilizer Dealer
_____ Extension Agent
_____ Other (specify)

26. Do you use a winter cover crop on your cotton fields, and if so what is it?

_____Yes (specify_____)
_____No

27. Would you be in favor of a boll weevil eradication program? Yes No

28. Why or why not? Please explain any concerns you have about boll weevil eradication.

Appendix III – Peanuts

Please answer the following questions regarding your peanut operation.

1. Number of Peanut Acres Grown _____

Please describe your peanut yields during the last ten years by answering the following questions.

Dryland Peanuts		Irrigated Peanuts	
2. Average Yield/Acre	_____ lbs	5. Average Yield/Acre	_____ lbs
3. Highest Yield/Acre	_____ lbs	6. Highest Yield/Acre	_____ lbs
4. Lowest Yield/Acre	_____ lbs	7. Lowest Yield/Acre	_____ lbs

8. How often do you have your soil tested? Every _____ years _____ Never

9. Do you follow the recommendations resulting from these soil tests? Yes No Partially

10. If not, how do you decide how much fertilizer to apply? *(Do not read choices)*

_____ Consultant's recommendations
_____ Fertilizer Dealer
_____ Doing what I have always done
_____ Read Extension Fact Sheets
_____ Other (specify)

11. What plant nutrients do you apply annually to your peanut crop? What is the rate of application? *(Do not read choices)*

Nutrient	Rate (Lbs/Acre)
_____ Nitrogen	_____
_____ Phosphate	_____
_____ Potash	_____
_____ Boron	_____
_____ Zinc	_____
_____ Magnesium	_____
_____ Sulphur	_____
_____ Gypsum	_____
_____ Lime	_____
_____ Micronutrients	_____
_____ Other (specify)	_____

Please answer the following questions regarding your primary peanut pest problems and the pesticides used to control them.

			Method of Application		
Insects (12)	Pesticide	Rate/Acre	Ground/Air	Self/Commercial	Soil/Foliar
Weeds (13)					
Diseases (14)					

15. How do you decide when to apply pesticides? *(Do not read choices)*
_____ Scout fields
_____ Calendar
_____ Extension Agent
_____ Consultant
_____ Do what I have always done in the past
_____ Other (specify)

16. If you scout your fields, approximately how long does it take you (or your scouts) to scout 10 acres of peanuts? _____

17. Do you rotate other crops with your peanuts? *a. Dryland* Yes No *b. Irrigated* Yes No

18. If yes, describe your crop rotation schedule.
Dryland –

Irrigated –

19. Do you irrigate any of your peanuts, and if so, how many acres? _____ *(If zero, skip remaining questions)*

20. If you irrigate, where do you get your irrigation water? *(Do not read choices)*
_____ Well Water
_____ Stream
_____ Pond
_____ Other (specify)

21. Do you have any problems with the quality of your irrigation water and if so, what are they? *(Do not read choices)*
_____ No problems.
_____ Salt
_____ Low water table
_____ Weed seeds
_____ Other (specify)

22. Do you use chemigation or fertigation? Yes No

23. If yes, what measures do you take to prevent backflow? How much did it cost to install?

24. How do you decide when to irrigate? *(Do not read choices)*
_____ Weather
_____ Condition of crop
_____ Soil moisture
_____ Calendar
_____ Feed/Fertilizer Dealer
_____ Extension Agent
_____ Other (specify)

25. Do you use a winter cover crop with your peanuts, and if so, what is it?
_____ Yes (Specify_____)
_____ No

Appendix IV – Wheat

Please answer the following questions regarding your wheat operation.

1. Number of Wheat Acres Grown _____

Please describe your wheat yields within the last ten years by answering the following questions.

2. Average Yield/Acre _____bushels
3. Highest Yield/Acre _____bushels
4. Lowest Yield/Acre _____bushels

5. How often do you have your soil tested? Every _____ years _____Never

6. Do you follow the recommendations resulting from these soil tests? Yes No Partially

7. If not, how do you decide how much fertilizer to apply? *(Do not read choices)*

_____ Consultant's recommendations
_____ Fertilizer Dealer
_____ Doing what I have always done
_____ Read Extension Fact Sheets
_____ Other (specify)

8. What is your tillage system for wheat? *(Do not read choices)*

_____ Clean Till
_____ No-Till
_____ Minimum Till
_____ Stubblemulch
_____ Other (specify)

9. After wheat harvest, how many tillage(s) do you do before planting? _____

10. What plant nutrients do you apply annually to your wheat crop? What is the rate of application? *(Do not read choices)*

	Nutrient	Rate (Lbs/Acre)
_____	Nitrogen	_____
_____	Anhydrous Ammonia	_____
_____	Phosphate	_____
_____	Potash	_____
_____	Zinc	_____
_____	Magnesium	_____
_____	Sulphur	_____
_____	Gypsum	_____
_____	Lime	_____
_____	Micronutrients	_____
_____	Other (specify)	_____

Do you use split applications? _____

Please answer the following questions regarding your primary wheat pest problems and the pesticides used to control them.

Insects (11)	Pesticide	Rate/Acre	Method of Application Ground/Air	Self/Commercial	Soil/Foliar
Weeds (12)					
Diseases (13)					

14. How do you decide when to apply pesticides? *(Do not read choices)*

_____ Scout fields
_____ Calendar
_____ Extension Agent
_____ Consultant
_____ Do what I have always done in the past
_____ Other (specify)

15. If you scout your fields, approximately how long does it take you (or your scouts) to scout 10 acres of wheat? _____

16. Do you rotate other crops with your wheat? Yes No

17. If yes, describe your crop rotation schedule.

18. Is any of your wheatland terraced, and if so, what percentage?
_____ Yes (_____%)
_____ No

Appendix VI – Livestock

What types of livestock do you raise?

	Number	Number Confined
1. Cow/Calf		
2. Stocker Cattle		
3. Feeder Cattle		
4. Dairy Cattle		
5. Other (specify)		

6. What is the source of drinking water for your livestock? *(Do not read choices)*
   _____ Pond
   _____ Stream
   _____ Well water
   _____ Rural Water
   _____ Other (specify)

7. Do your cattle have free access to streams and/or ponds? Yes No

8. Have you heard of the EPA's CAFO (Confined Animal Feeding Operations) regulations? Yes No

9. If so, where have you heard about them? *(Do not read choices)*
   _____ Farm Magazines
   _____ Newspapers
   _____ Television
   _____ Other Farmers/Neighbors
   _____ Pesticide/Feed Dealer
   _____ Cooperative Extension Service
   _____ Farm Organizations (Cattleman's Association, Hay Growers' Association, etc.)
   _____ ASCS or SCS
   _____ Other (specify)

10. Have CAFO regulations affected your operation? Yes No

11. Do you expect CAFO regulations to cause you to make changes in your operation in the near future? Yes No Why or Why Not?

12. Do you expect CAFO regulations to cause financial hardships in your operation? (If so, give approximate dollar amount.) $_____

13. Do you think CAFO or a similar type of regulation has value to the environment? Yes No Maybe
    Why or why not?

14. Do you presently have a lagoon or waste storage pond for animal waste? Yes No *(If no, skip to number 17)*

15. Was it designed by the SCS? Yes No
If not, how was it designed?

16. How old is it? _____ years

17. How big is it? _____ (surface acres)

18. Do you ever pump effluent out of it? Yes No If so, how often? _____

19. If no, do you ever expect to pump it? Yes No

20. How often does it run over?
_____ Always
_____ Occasionally
_____ Rarely
_____ Never

21. Are you concerned about manure disposal? Yes No

22. What specific things are you most concerned about?

i. Pesticides can be harmful to water quality.
____SA ___A ___N ___D ___SD

j. Fertilizers can be harmful to water quality.
____SA ___A ___N ___D ___SD

k. Pesticides have more potential for harm to water quality than fertilizers.
____SA ___A ___N ___D ___SD

l. I am more concerned about water quality now than I was five years ago.
____SA ___A ___N ___D ___SD

m. Nonpoint source pollution is a more serious threat to water quality than point source pollution.
____SA ___A ___N ___D ___SD

24. How often do you have your soil tested?
_____

25. Do you follow the recommendations from these soil tests?
_____Yes _____No _____Partially
If you don't follow the recommendations, how do you decide how much fertilizer to apply?_____
_____

26. What is your primary pest problem and the pesticide you use to control that pest?
Crop_____ Pest_____ Pesticide_____
Crop_____ Pest_____ Pesticide_____
Crop_____ Pest_____ Pesticide_____

27. What do you use as a basis to determine when to apply pesticides?
_____

28. What is your tillage system?

Crop	Tillage system	Number of tills
_____	_____	_____
_____	_____	_____
_____	_____	_____

29. Where do you get your irrigation water?
_____

30. What pollution problems do you have with your irrigation water?_____
_____

31. How do you decide when to irrigate?
_____
_____

32. What cover crops do you use?

Primary Crop	Cover Crop	What Rotation
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

33. What Cooperative Extension programs would you like to see addressing water quality?_____
_____
_____
_____

Please include any other comments or suggestions you would like to make._____
_____
_____
_____
_____
_____
_____
_____
_____

Thank you for your cooperation!

Barnitz Creek Agricultural Producer Survey

Seeking your opinions and knowledge to help us serve you, the producer, better and protect your water quality in the process.

Sent to you by the Custer County Cooperative Extension Service

OSU
OKLAHOMA COOPERATIVE EXTENSION SERVICE

1. What is the size of your farming operation (acres farmed)?

_____

2. Approximately what percentage of farming income comes from the following areas:
Alfalfa_____Cotton_____
Peanuts_____Wheat_____
Livestock____Other_____

3. If you do not have livestock skip to # 11

4. How many head of livestock do you have?

_____

5. What is the source of drinking water for your livestock?
_____Pond_____Stream
_____Well water_____Rural water
_____Other (specify)_____

6. Do your cattle have free access to streams and/or ponds?
_____Yes _____No

7. Are you concerned about manure disposal?
_____Yes _____No

8. Do you currently have a lagoon or waste storage pond for animal waste?
_____Yes _____No

9. How have Confined Animal Feeding Operations (CAFO) regulations affected your operation?

_____
_____
_____

10. Do you think CAFO regulations help improve the environment?
_____Yes _____No

11. What is the source of your household drinking water?

_____

12. When was the last time you had your household drinking water tested?_____

13. Are there any problems with your drinking water involving the following:
____Bacteria _____Pesticides
____Nitrates _____Other (specify)_____

14. How would you rate water quality on your farm?
____Serious problem____Moderate problem
____Slight problem____Not a problem

15. What is a potential source for water pollution on your farm/ranch?_____

_____

16. How would you rate current overall water quality in your area?
____Serious problem _____Moderate problem
____Slight problem _____Not a problem

17. Compared to ten years ago, do you think water quality in your area is:
____Better _____About the same
____Worse _____Don't know

18. What do you think are the major causes of water pollution in your area?_____

_____
_____

19. What are significant agricultural sources for water pollution in your area?_____

_____

20. What is a specific site in your area where water pollution is occurring?_____

_____

21. Do you currently have any ASCS or SCS contracts, such as cost-share or incentive programs, for your farm?_____No _____Yes
If yes, please describe_____

_____
_____

22. What Best Management Practices (BMPs) do you currently use?_____

_____
_____

23. FOR EACH OF THE FOLLOWING STATEMENTS INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH EACH OF THE FOLLOWING STATEMENTS.
Strongly Agree = SA Agree = A Neutral = N
Disagree = D Strongly Disagree = SD

a. Farm practices that protect water quality usually require more labor.
__SA ___A ___N ___D ___SD

b. Agricultural water pollution is a serious threat to fish and wildlife.
__SA ___A ___N ___D ___SD

c. Agriculture is being unfairly blamed as a cause of water quality problems.
__SA ___A ___N ___D ___SD

d. If farm operators don't do more to protect water quality on their own, the government will force them to , through regulation.
__SA ___A ___N ___D ___SD

e. The government should help pay for water pollution control on farms.
__SA ___A ___N ___D ___SD

f. Farm operators have the right to farm in any way they choose, even in ways that damage water quality.
__SA ___A ___N ___D ___SD

g. Land owners have a responsibility to farm in ways that protect water quality.
__SA ___A ___N ___D ___SD

h. Water pollution can best be controlled through farm operators use of BMPs.
__SA ___A ___N ___D ___SD

The Instrument

LANDUSER / PRODUCER SURVEY

POTEAU RIVER PROJECT

Black Fork Watershed

[ ] I live in the Blackfork Watershed and operate a farm.
Number of acres_____

Do you: own / lease / rent (circle one)

[ ] I do not operate a farm, but, I live in the Blackfork Watershed.

1. Where does your household water come from?
   a) PVIA
   b) Private well
   c) Other (describe)

2. Has your household water been tested in the past 2 years? yes or no

3. Are you aware of the Lake Wister Water Quality Project? yes or no

4. Do you use Lake Wister for recreation? Please describe.

5. What do you think of the quality of Lake Wister (rate from good to bad 1-4). 1 - 2 - 3 -4

6. Do you raise beef cattle? yes or no
   If yes how many? _____

7. Do you raise poultry? yes or no
   If yes what kind? _____

   a) How many houses do you have? _____, and what is the capacity of each house? _____.
   b) What kind of bedding do you use?
   c) Who cleans out your poultry houses?
      Self
      contractor
   d) Do you clean cake after each batch of chickens? yes or no

e) When do you clean our houses?
f) Where do you spread litter?
- on your own pastures
- on rented land
- sell it
- give it to neighbors
- contractors takes it away

8. What application rate do you shoot for?

9. Do you test your litter for nutrient content? yes or no

10 Do you have a place to store litter between clean out and spreading? Yes or no. Please describe _____.

11. Do you have an NRCS, Conservation District waste utilization plan?

12. How do you dispose of dead chickens? composter, incinerator, other.

13 If you don't apply poultry litter to your pastures do you apply commercial fertilizer? yes or no. If so, at what rate? _____

14. Does your pasture have a creek running through it? yes or no
If yes, does it flow year round? yes or no

15 For demonstration purposes would you establish a controlled riparian streambank area along the creek on your property? yes or no
or a buffer strip? yes or no

16. Would your septic system meet OK Health Department criteria? yes or no

17. Do you have a Conservation plan with the LeFlore Count Conservation District? yes or no

18. Have you had a soil test on your pasture within the last 2 years? yes or no

19. Do you have active erosion occurring on your pastures? yes or no

20. What type grazing system do you use? continuous, rotational, or short duration grazing.

21. Do you practice weed control? yes or no
If yes, do you mow or spray
If you spray, what do you use? _____.

14. Are there any problems with your drinking water involving the following:
_____Bacteria _____Pesticides
_____Nitrates _____Other (specify)_____

15. What Best Management Practices (BMPs) do you currently use for the following:
Animal waste_____
Pasture_____
Riparian areas_____
Forestry_____
Septic system_____
Other_____

16. FOR EACH OF THE FOLLOWING STATEMENTS INDICATE THE EXTENT TO WHICH YOU AGREE OR DISAGREE WITH EACH OF THE FOLLOWING STATEMENTS. Strongly Agree = SA Agree = A Neutral = N Disagree = D Strongly Disagree = SD

a. Farm practices that protect water quality usually require more labor.
____SA ___A ___N ___D ___SD

b. Farm practices that protect water quality usually require more financial investment.
____SA ___A ___N ___D ___SD

c. Agricultural water pollution is a serious threat to fish and wildlife.
____SA ___A ___N ___D ___SD

d. Agriculture is being unfairly blamed as a cause of water quality problems.
____SA ___A ___N ___D ___SD

e. If farm operators don't do more to protect water quality on their own, the government will force them to , through regulations.
____SA ___A ___N ___D ___SD

f. The government should help pay for water pollution control on farms.
____SA ___A ___N ___D ___SD

g. Farm operators have the right to farm in any way they choose, even in ways that damage water quality.
____SA ___A ___N ___D ___SD

h. Water pollution can best be controlled through farm operators' use of Best Management Practices.
____SA ___A ___N ___D ___SD

i. Commercial fertilizer is less of a water quality problem than poultry litter.
____SA ___A ___N ___D ___SD

j. I am more concerned about water quality now than I was five years ago.
____SA ___A ___N ___D ___SD

k. Nonpoint source pollution is a more serious threat to water quality than point source pollution.
____SA ___A ___N ___D ___SD

17. Have you had a soil test on your pasture within the last two years?
_____Yes _____No

18. If you have not soil tested within the last two years, how do you decide the amount of fertilizer or litter to use?
Fertilizer_____
Litter_____

19. Do you have active erosion occurring on your pastures?_____Yes _____No

20. Does your septic system meet Oklahoma Health Department criteria?
_____Yes _____No

21. How would you rate the water quality of Lake Wister?(circle one)
Very Good Good Bad Very Bad

22. What educational programs would you like to see addressing water quality?_____
_____
_____

Haw Creek Agricultural Producer Survey

Seeking your opinions and knowledge to help us serve you, the producer, better and protect your water quality in the process.

This questionnaire will be used to evaluate the effect of the Water Quality Program conducted by the LWPR Advisory Committee, Leflore County Conservation District, OSU Extension and NRCS. Your answers are confidential. Thank you for your cooperation with this survey.

1. What is the size of your farming/ranching/poultry operation?
_____ acres

2. Approximately what percentage of farming income comes from the following areas:
Cattle_____Poultry_____
Hay_____Forestry_____
Other_____(explain)_____

3. Approximately what percentage of your total household income comes from agriculture/forestry?
_____

4. LIVESTOCK: If you do not have livestock, skip to question #5

a. What is your approximate number of mature cattle? (circle)

none	1-25	26-50
51-75	76-100	101-125
126-150	151-175	176-200
201-225	226-250	251-275 _____

b. What is the source of water for your livestock?
_____Pond_____Stream
_____Well water_____Rural water
_____Other (specify)_____

c. Do you have any streams running through your pastures?
_____Yes _____No
If yes, do they flow year round?
_____Yes _____some do _____No

d. If you do have streams running through your pastures, do you have either of the following:
_____controlled riparian streambank area
_____buffer strip

e. Do your livestock have free access to streams and/or ponds?_____Yes _____No

f. What type of grazing system do you use?
_____continuous_____rotational
_____short duration

g. Do you practice weed control?
_____Yes _____No
If yes, do you mow or spray? (circle)
If you spray what do you use?_____

5. POULTRY: If you do not raise poultry please skip to question #6

A. How many poultry houses do you have?
_____

B. What is the capacity of each house?
_____

C. What is the total number of poultry you produce annually?
_____

D. Who cleans out your poultry houses?
____self _____contractor _____other_____

E. Do you clean cake after each batch of chickens?
____Yes _____No

F. Please estimate what percentage of your litter was:
_____utilized as fertilizer on your owned land
_____utilized as fertilizer on land you rent/lease
_____sold by you to be utilized as fertilizer
_____utilized as cattle feed by you
_____sold by you to be utilized as cattle feed
_____given away to neighbor for fertilizer
_____given away to neighbor for cattle feed
_____taken away by "clean-out" or "cake out" contractor
_____other (explain)_____

G. If you spread your litter, what application rate do you use?
_____tons/acre

H. Do you test your litter for nutrient content?
_____Yes _____No

I. If you don't apply poultry litter to your pastures, do you apply commercial fertilizer?
_____Yes _____No If yes, at what application rate?_____

J. Do you currently have facilities to store poultry litter on your farm?
____Yes _____No
If yes, what is the total weight of poultry litter you can store?_____tons

K. Are you concerned about litter disposal?
____Yes _____No

L. Do you have an NRCS, Conservation District waste utilization plan?
___Yes _____No

M. How do you dispose of dead chickens?
___Composter ____Freezer _____Burn
____Bury ____Render _____Other

6. Do you have a Conservation plan with the LeFlore County Conservation District?
___Yes _____No

7. How would you rate current overall water quality in your area?
___Serious problem _____Moderate problem
___Slight problem _____Not a problem
___Don't know

8. Compared to ten years ago, do you think water quality in your area is:
___Better _____About the same
___Worse _____Don't know

9. What do you think are the major causes of water pollution in your area?_____
_____

10. Do you think agriculture is a significant cause of water pollution in your area?
___Yes ___No

11. How would you rate water quality on your farm/ranch?
___Serious problem___Moderate problem
___Slight problem____Not a problem
___Don't know

12. What is the source of your household drinking water?
____private well _____rural water
____city water _____other (explain)_____

13. Has your household water been tested in the past 2 years?
_____Yes _____No

APPENDIX B

INSTITUTIONAL REVIEW BOARD

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 06-08-97 **IRB#:** AG-97-022

Proposal Title: POULTRY LITTER MANAGEMENT PRACTICES OF AGRICULTURAL PRODUCERS IN A SOUTHEASTERN OKLAHOMA WATERSHED

Principal Investigator(s): James P. Key, Lucia Kafidi, Troy A. Pierce

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:
This application is exempt. The study is analyzing apparently anonymous extant data.

Signature: _____ Date: June 10, 1997
Chair of Institutional Review Board

cc: Lucia Kafidi
Troy A. Pierce

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 08-04-97 **IRB#:** AG-98-003

Proposal Title: HAW CREEK AGRICULTURAL PRODUCER SURVEY

Principal Investigator(s): James P. Key, Troy A. Pierce

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: _____ Date: August 5, 1997
Chair of Institutional Review Board
cc: Troy A. Pierce

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 10-28-97 **IRB#:** AG-98-010

Proposal Title: BARNITZ CREEK AGRICULTURAL PRODUCER SURVEY

Principal Investigator(s): James P. Key, Troy A. Pierce

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:
COMMENTS:
>This project presents "minimal risk" factors to participants.
>Confidentiality is maintained through the use of anonymous surveys.

SUGGESTIONS:
It appears that the second survey has already been disseminated (Summer 1997). If it has not, it is suggested that an information letter about the study be provided to subjects when obtaining verbal consent.

Signature: _____ Date: October 30, 1997
Chair of Institutional Review Board
cc: Troy A. Pierce

VITA

Troy Alen Pierce

Candidate for the Degree of

Doctor of Philosophy

Thesis: AN EVALUATION OF MANAGEMENT PRACTICE USAGE AND WATER QUALITY EDUCATION IN SELECTED OKLAHOMA WATERSHEDS

Major Field: Agricultural Education

Biographical Data:

Personal Data: Born in Wichita, Kansas, on October 28, 1965, son of Le McKeown and James Pierce.

Education: Graduated Edmond Memorial High School, Edmond, Oklahoma, May, 1984; received Associate of Arts degree from Seminole Community College, Sanford, Florida, August, 1990; graduated from the University of Central Florida, Orlando, Florida, December, 1992, with a Bachelor of Science degree in Molecular Biology and Microbiology; graduated from Oklahoma State University, Stillwater, Oklahoma, July, 1995, with a Master of Science degree in Agricultural Education; completed requirements for the Doctor of Philosophy in Agricultural Education, Oklahoma State University in December, 1997.

Professional Experience: House Manager for the Orlando Science Center, Orlando, Florida, 1991-1992. Biological Technician for USDA, ARS, US Horticultural Research Lab, Orlando, Florida, 1992-1993. Student Professional for the Department of Horticulture, Oklahoma State University, 1994 to 1995. Agriculture Experiment Station Research Assistant, 1995 to present.

Organizations and Awards: Phi Theta Kappa, Phi Delta Kappa, and Gamma Sigma Delta. Parlett award for outstanding chemistry student, 1990. OSU GSA President 1996/97. NAGPS Board of Directors, 1997.