How Attitudes of Important Stakeholder Groups Can Influence Effective Water Quality Management

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Abstract

Preliminary results of a survey of Lincoln Lake agricultural and non-agricultural watershed residents as well as water quality regulators/specialists suggests discrepancies exists in different groups perceptions of water quality, the sources of water pollution, and the roles of local, county, state and federal officials in meeting water quality objectives.

JEL codes: Q25, Q53, Q59

Introduction

The Lincoln Lake watershed in Northwest Arkansas is a rapidly growing area that is home to animal agriculture, urban dwellers and industry. The watershed is a sub-watershed of the Illinois River basin that expands across Northwest Arkansas and Northeastern Oklahoma (see Figure 1). This area is home to thousands of poultry farms and pastures that produce abundant forage for numerous beef and dairy cattle. While animal manure has been used effectively as a fertilizer for pasture grasses, concerns exist that that excess land applications of animal manure can lead to surface and ground water pollution due to increased runoff of nitrogen (N) and phosphorus (P), sediment, and pathogens (e.g., Edwards et al., 1996). As surface waters cross state and county borders, disputes arise, not only across state lines but among agricultural landowners, poultry producers, environmentalists, and other stakeholders within the watershed itself. Stakeholders generally feel unrepresented in the policy process. As a result, they turn to the courts to address their disputes while policies that effectively address concerns have yet to materialize.

Debate exists as to whether stakeholder involvement in the policy process can improve policy decisions (Yosie and Herbst, 1998). For instance, Kiker et al. (2005) argue that environmental issues are complex and because they encompass trade offs among environmental, ecological, economic and socio-political factors it is difficult to meet all stakeholders groups' preferences. Likewise, environmental management requires extensive coordination and consensus building. Information asymmetry can be an impediment to achieving consensus among different stakeholder groups (Bourgeois and Franck, 2006).

However, others affirm the importance of widespread inclusion of and collaboration among various stakeholder groups and policy makers in the development of effective environmental policy (Bates et al., 1993; Brown and Marshall, 1998; Keiter, 1995; Koontz and Johnson, 2004; Ananda and Herath, 2006). Approaches that combine participatory learning as a tool to share information will help parties involved to reduce information asymmetry (Bourgeois and Franck, 2006). Among the factors identified that influence the success of collaborative efforts among stakeholder groups are degree of public involvement in the process, government interaction with the public, level of scientific certainty and stakeholders knowledge of the issues (Durham and Brown, 1999; Kellogg 1998; O'Leary et al., 1999; Thomas 1999).

In 2006 a Conservation Effects Assessment Project (CEAP) project was established within the Lincoln Lake watershed that integrates research, extension, and education activities through a stakeholder-guided process to measure, model, and predict watershed scale water quality. This stakeholder-guided process will help ensure that a water quality management plan can be developed that cannot only effectively reach water quality goals but do so in a manner that is understood and accepted by stakeholders in the watershed. The objectives of this project were to: 1)to collect stakeholders perceptions of watershed water quality and sources of water pollution 2) to understand how stakeholders view the roles of local, county, state and federal officials in meeting water quality objectives, and 3) to determine how that information can be used to help move stakeholders from conflict to cooperation in meeting desired water quality goals. In this paper we will present the results of the first two objectives of the stakeholder study. This will represent the first such detailed dataset of its kind in the region. These results will be used to develop further research and education objectives that can be used to help move stakeholders from conflict to cooperation in meeting desired water quality goals.

Methods

Three surveys were developed for relevant stakeholders: 1) one survey for agricultural producers within the watershed (agricultural stakeholders); 2) one for all other land/home/business owners within the watershed (non-agricultural stakeholders); and 3) one for county/state/federal water quality specialists and regulators (specialists) in the state. These surveys solicited stakeholders' perceptions of: 1) watershed water quality, 2) potential sources of water quality degradation, 3) effectiveness of 15 locally relevant agricultural best management practices (BMPs) that can be used to address nutrient and sediment runoff and 4) the interaction of policy makers and agricultural/non-agricultural stakeholder groups on water quality issues. Focus groups consisting of agricultural and non-agricultural stakeholders (from surrounding watersheds) and water quality specialists (from surrounding states) were conducted to identify, clarify and pretest survey questions.

Washington County assessor's office records were used to identify all land and business owners within the Lincoln Lake Watershed. These individuals were then placed in the relevant stakeholder category (75 agricultural and 243 non-agricultural stakeholders). Survey data were collected during meetings held within the watershed during the months of July through September (separate meetings for agricultural and non-agricultural stakeholders). Mail surveys were sent to stakeholders absent from these meetings in October and November. Final survey responses were received in early February.

The 160 specialists surveyed were comprised of 10 University of Arkansas (UA), 34 UA Cooperative Extension Service (CES), 14 Conservation Districts (CD), 49 Natural Resources Conservation Service (NRCS), 25 Arkansas Department of Environmental Quality (ADEQ), and 28 Arkansas Natural Resources Commission (ANRC) personnel. Surveys were mailed in early March. Follow up was conducted in early April. This paper includes preliminary results from surveys received by May 1, 2007. Summary statistics have been calculated for all responses and chi-square or Fisher Exact tests have been conducted for responses of selected questions. Further statistical analyses will Summer when the final data collection period has ended.

Results

Respondent Characteristics

Eighty-four percent of agricultural stakeholders participated in the survey. Over half of these respondents listed cattle (61%) and hay production (59%) among their agricultural activities. Pasture production (43%), broiler production (20%), other poultry production (35%), other livestock (16%) and other activities (18%) completed the agricultural activities in which they engaged. This mix of activities is typical in the watershed.

Twenty-eight percent of non-agricultural stakeholders participated in the survey. These stakeholders reported their Lincoln Lake watershed land use as their primary residence (83%), a business location (20%), a rental property (12%) or recreation (14%) or land preservation purposes (9%). While the response rate is lower than that of the agricultural stakeholders, these land uses are also representative of the watershed.

Seventy eight (or 49%) of the specialists responded to the survey. Seventy six respondents identified themselves as employees of UA (8), CES (22), CD (6), NRCS (19), ADEQ (6), and ANRC (14). Response rates for individual employer groups ranged from 24% for ADEQ to 80% for UA. Due to the small number of responses within each employer group limited subgroup (employer level) analyses were conducted.

Perceptions of Water Quality

All agricultural and non-agricultural stakeholders, and those experts familiar with the Lincoln Lake watershed were asked were asked to give their perceptions of three bodies of water within the watershed – Lincoln Lake, Moores Creek and Beatty Branch. They were presented with statements suggesting these three water bodies were suitable for three particular uses – drinking (once treated), swimming and fishing - nine water body/use combinations (Table 1). Significant differences ($p < 0.05$) existed among the stakeholder groups regarding the drinkability of the two stream water bodies. In both cases agricultural producers were more likely to agree than others that Moores Creek and Beatty Branch were suitable for drinking, once treated. Significant differences also existed in the opinions regarding the suitability of all three water bodies for swimming. In all of these cases a greater percentage of agricultural stakeholders believed the quality of the water bodies was suitable for its purpose compared to non-agricultural stakeholders and specialists.

Water Quality Pollution and Protection

All stakeholders were asked how much of a contribution did six different groups make to water quality problems related to nutrient and sediment runoff (Table 2). Significant differences existed in stakeholder opinions regarding all sources of pollution. With the exception of outdoor recreation, a greater percentage of specialists than watershed stakeholders believed that all potential sources contributed largely to nutrient and sediment induced water quality concerns. Interestingly, 45.4% of specialists believed agriculture contributed largely to water quality issues, but this potential source ranked third behind new construction (71.1%) and city sewer systems (49.3) as a large contributor. Over 40% of non-agricultural stakeholders believed that agriculture was a large contributor to water quality problems in the area, while only 5% of agricultural respondents felt the same way. Nearly 20% of agricultural stakeholders reported than agriculture contributed nothing to water quality problems, while only 7% of non-agricultural producers felt this way. Non-agricultural respondents most often selected agriculture and new construction as large contributors to pollution while agricultural respondents most often selected new construction and industry as the largest contributors.

Respondents were then asked their opinions as to who of those seven groups mentioned above should be responsible for cleanup (Table 3). In general responses mirrored those opinions as to who contributed to the problem (Table 2). Significant differences existed for all potential contributors, except households. While only 4% of agricultural stakeholders felt agriculture made a large contribution to the problem, 8% or double the percent of agricultural stakeholders felt agricultural should have a large responsibility in the cleanup. Conversely, while only 6.6 % of non-agricultural stakeholders felt agriculture made no contribution to the problem, 16.7% felt agriculture had no responsibility to clean up. Specialists placed the largest responsibility for clean up on new construction, city sewer systems and industry.

Effectiveness of Best Management Practices

Agricultural land dominates the land use in the watershed. Therefore, all stakeholders were asked their opinions regarding the effectiveness of 15 possible best management practices (BMPs) that agricultural producers could use to protect water quality from nutrient and sediment runoff. These practices in general have been identified for use in nutrient surplus regions of the state, such as Lincoln Lake Watershed. Agricultural producers have access to technical assistance for many of these practices from university and governmental specialists and therefore it was presumed before the surveys that agricultural producers and specialists would have knowledge of these practices and their effectiveness. Non-agricultural stakeholders were asked the same question to gauge the extent of their knowledge of agricultural activities. Not surprisingly, for 13 of the 15 BMPs at least half of the non-agricultural respondents ignored this question or stated they were unsure of their effectiveness. These results suggest that non-agricultural stakeholders are unaware of BMPs used by farmers in their area. Therefore, comparisons of the opinions of best management practice effectiveness were conducted only between agricultural stakeholders and specialists. Significant differences were found for 10 of the 15 practices (Table 4). Three findings are of note. First, in six of those cases, at least 28% of the agricultural stakeholders stated they did not know if the practice was effective, This suggests information may not be as readily available to producers as previously thought. Second, farmers were much more likely to agree than specialists that using manure instead of commercial fertilizer was an effective BMP. Third, while over 90% of specialists believe a Comprehensive

Nutrient Management Plan is effective – and it is heavily promoted to farmers in the state – only half of the agricultural stakeholders felt the same way.

Interaction with Government in the Policy Making Process

Finally all stakeholders were asked questions regarding their inclusion in the water quality policy making process. While roughly 44% percent of both stakeholder groups felt government officials invited them to participate in the process, only 20% of agricultural and 29% of non-agricultural respondents felt that government officials listened to their opinions. Reasons for these opinions may be presumed from further responses. For example, Table 5 shows significant differences in opinions between agricultural stakeholders and specialists (who include state and federal government personnel) as to which level of government represents agricultural producers best. Agricultural stakeholders overwhelmingly felt that county-level officials best represented their water quality needs and concerns whereas specialists were more evenly split across all three levels of government. (Comparisons of non-agricultural stakeholders and specialists are still being conducted). At one third of all agricultural, nonagricultural and specialist respondents believe that these county level officials needed a lot more power/authority to carry out water management polices effectively (Table 6). Significant differences existed only with regards to state government. A higher percentage of specialists than watershed stakeholders believe that state government officials need a lot more power to effectively conduct water quality policy.

DISCUSSION

For decades, debate has ensued over water quality within the greater Illinois River Basin, which includes the Lincoln Lake watershed. To date no comprehensive water quality policy exists for the region and as a result, many conflicts have played out in the courts, and continue to do so, but with little resolution. A review of the literature suggests that stakeholder involvement is critical to the development of effective environmental policy; however, the success of collaborative efforts among stakeholder groups can hinge upon stakeholders' knowledge of the issues, governmental interaction with the public, and the level of scientific certainty surrounding the environmental concerns. Our surveys of Lincoln Lake Watershed stakeholders provide some insight into these factors.

First, the collected data suggest, not surprisingly, that opinions vary widely among the two watershed stakeholder groups and the specialists regarding the existence of water quality problems and the potential sources of that pollution within the watershed. Specialists tended to fall between opinions of agricultural and non-agricultural stakeholders concerning the suitability of Lincoln Lake watershed water bodies for drinking, fishing and swimming. However, only a small portion of the three respondent groups felt the water bodies were unsuitable for these uses.

Opinions also vary greatly among groups as to the contributors of nutrient and sediment related water quality problems. For example, a very small percentage of agricultural stakeholders identified agriculture as a large contributor compared to non-agricultural and specialists' responses. However, new construction was the most often cited large contributor by agricultural stakeholders and specialists, cited by over 50% of both groups. Agriculture, the most often cited large contributer by non-agricultural stakeholders was cited by only 41% of that group. The burden of cleanup fell along the same lines. However, all three groups both were most likely to indicate new construction, city sewer systems and industry as most deserving of a large responsibility for clean-up. So while much local attention has been turned towards agriculture and its potential role in water quality problems, watershed stakeholders and specialists seem to perceive that water quality problems are generated from multiple sources that include sources beyond agriculture such as new construction and industry.

Survey results have provided three unexpected insights. First, while results suggest that non-agricultural stakeholders are unfamiliar with agricultural BMPs and their effectiveness, these same stakeholders are likely to target agriculture as a large contributor to water quality problems. Further research is needed to understand whether this lack of recognition of BMPs has contributed to the belief that agriculture is responsible for water quality problems in the area. Second, while agricultural BMP assistance is available from multiple governmental/educational institutions in Washington County, still nearly one-third of the agricultural stakeholders stated they were not sure about the efficacy of six BMPs listed. Furthermore, only seven practices were perceived as efficient by at least two thirds of agricultural producers. These results suggest two things. First, educational efforts might be targeted to non-agricultural stakeholders regarding the effectiveness of agricultural BMPs. Survey follow-up with agricultural producers is needed to understand whether producer's lack of knowledge of BMP efficiency is due to lack of information regarding the BMP or lack of relevance of that BMP to their production system.

Finally, as expected, watershed stakeholders perceive a lack of true collaboration with government officials in the policy making process. Neither stakeholder group believes that government officials incorporate their concerns and suggestions into the policy making process. The data also suggest that stakeholders believe there is a disconnect in representation and power at different levels of government. Both watershed stakeholder groups believe county level officials represent their concerns best but also believe these officials lack power to design and implement water quality policy relevant to watershed stakeholder groups. In the level of government (particularly federal level) where they believe most policy is set, they feel they have little representation. Specialists however were split in their opinion as to which level of government represents agricultural stakeholders best and tended to offer more power to state level officials than did watershed stakeholders.

Together all of these results suggested that much work is needed to improve the knowledge base of stakeholders and their interaction with government officials if stakeholder involvement is to contribute to effective environmental policy. While these results were expected, the survey data provided insights into these factors that were heretofore unsubstantiated. Collecting information regarding water quality perceptions from different watershed stakeholders and BMP use is also critical for modeling and predicting water quality more accurately and can thus improve the scientific certainty surrounding the status of water quality and the factors that influence water quality in the watershed. Involving all types of watershed stakeholders from the planning stage to the implementation stage is important to promote cooperation among watershed stakeholders, policy makers and regulators. In addition, it helps researchers to understand the adoption of certain BMPs as well as to understand the challenges and limitations faced by different groups. It is hoped that these results help identify the research educational needs within the watershed that will help guide the development of a water quality management plan that is acceptable to different types of stakeholders within the Lincoln Lake Watershed and that the methods and tools developed here can be applied across the nation where effective water quality management is a challenge in embattled watersheds impacted by excess application of animal manure.

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Table 1. Perceptions of respondents that water in the Lincoln Lake Watershed lakes and streams is good for three different uses

	Agricultural	Non Agricultural	Specialists	Agricultural	Non Agricultural	Specialists	Agricultural	Non Agricultural	Specialists
DRINKING (once treated)									
	Lincoln Lake (p=0.2393)*			Moores Creek (p=0.0240)*			Beatty Branch (p=0.0067)*		
Agree	79.4	60.9	72.2	79.0	55.0	61.1	78.7	47.2	55.6
Neutral	14.3	25.0	16.7	14.5	33.3	16.7	16.4	39.6	27.8
Disagree	6.4	14.1	11.1	6.5	11.7	22.2	4.9	13.2	16.7
FISHING									
	Lincoln Lake (p=0.3078)*			Moores Creek (p=0.4778)			Beatty Branch (p=0.0815)		
Agree	77.4	73.4	57.9	60.7	44.3	50.0	58.3	34.6	44.4
Neutral	21.0	21.9	42.1	32.8	44.3	38.9	30.0	54.6	50.0
Disagree	1.6	4.7	0.0	6.6	11.5	11.1	11.7	10.9	5.6
SWIMMING									
	Lincoln Lake (p <0.0001)			Moores Creek (p=0.0035)			Beatty Branch (p=.00230)		
Agree	58.1	20.3	22.2	45.9	18.3	22.2	43.3	16.4	22.2
Neutral	32.3	40.6	55.6	41.0	43.3	50.0	38.3	50.9	55.6
Disagree	9.7	39.1	22.2	13.1	38.3	27.8	18.3	32.7	22.2

* indicates Fisher Exact test was used, otherwise test for equality of distribution of the three groups was conducted with a chi-square. Table entry as a percentage of respondents in that group selecting that response.

Table 2. Respondents' perceptions (percent of respondents) as to who contributes to any existing water quality problems

Agricultural (%)			Non-Agricultural (%)			Specialists (%)		
None	Small	Large	None	Small	Large	None	Small	Large
New Construction (p = 0.0003)								
9.7	38.7	51.6	20.3	40.7	39.0	1.3	27.6	71.1
Industry (p = 0.0019)								
21.0	50.0	29.0	23.3	46. 7	30.0	1.4	55.4	43.2
City Sewer System (p = 0.0014)								
19.7	54.1	26.2	12.5	57.1	30.4	1.3	49.4	49.3
Households (p = 0.0033)								
19.4	56.5	24.2	18.6	57.6	23.7	1.3	59.7	39.0
Outdoor Recreation (p = 0.0094)								
54.1	41.0	4.9	50.9	40.4	8.7	25.0	73.7	1.3
Agriculture (p < 0.0001)								
19.4	75.8	4.8	6.6	52.5	41.0	1.3	53.3	45.4

* indicates Fisher Exact test was used, otherwise test for equality of distribution of the three groups was conducted with a chi-square. Table entry as a percentage of respondents in that group selecting that response.

Table 3. Respondents' perceptions as to who should be responsible to clean up

Agricultural *			Non-Agricultural			Specialists		
None	Small	Large	None	Small	Large	None	Small	Large
New Construction (p = 0.0007)								
9.8	36.1	54.1	14.0	42.1	43.9	1.3	29.3	69.4
Industry (p = 0.0001)								
12.9	50.0	37.1	13.2	45.3	41.5	0	43.2	56.8
City Sewer System (p < 0.0001)								
21.0	53.2	25.8	14.8	44.4	40.7	0	37.3	62.7
Households (p = 0.1376)								
19.7	55.7	24.6	20.0	54.6	25.5	5.6	59.7	34.7
Outdoor Recreation (p < 0.0001)								
47.5	47.5	5.0	47.2	35.9	17.0	22.2	68.1	9.7
Agriculture (p = 0.0007)								
25.0	66.7	8.3	16.7	43.3	40.0	2.7	50.0	47.3

*Table entry as a percentage of respondents in that group selecting that response.

Table 4. Agricultural best management practices are effective in reducing nutrient and/or sediment loss from agricultural lands: perceptions of agricultural stakeholders

Group	Agricultural			Specialists			P Value
	Agree	Disagree	Not Sure	Agree	Disagree	Not Sure	
Soil Test	86.4	1.7	11.9	87.0	7.8	5.2	0.1266*
Pasture Grass Management	82.5	7.0	10.5	90.8	5.3	4.0	0.2997*
Use of Manure Instead of Commercial Fertilizer	82.1	3.6	14.3	52.0	32.5	15.6	0.0001
Basing Fertilizer Application on Soil Test Results	80.0	5.0	15.0	97.3	0.0	2.7	0.0031*
Controlled Grazing	77.6	10.3	12.1	88.3	5.2	6.5	0.2471
Filter Strips for Riparian Areas	73.7	3.5	22.8	94.8	3.9	1.3	<0.0001*
Use of Legumes to Reduce Nitrogen Applications	73.6	3.8	22.6	68.0	20.0	12.0	0.0147
Prescribed Grazing	63.8	15.5	20.7	76.6	5.2	18.2	0.1036
Litter Storage	56.1	15.8	28.1	79.2	14.3	6.5	0.0021
Cattle Track Stabilization	53.6	8.9	37.5	68.0	6.7	25.3	0.2407
Comprehensive Nutrient Management Plan	51.8	8.9	39.3	92.1	6.6	1.3	<0.0001
Composting Manure	51.0	5.9	43.1	62.3	19.5	18.2	0.0032
Stream Fencing	50.0	18.5	31.5	81.6	13.2	5.3	<0.0001
Stream Bank Stabilization	43.6	12.7	43.6	92.2	5.2	2.6	<0.0001
Waste Treatment Lagoon	12.5	16.1	71.4	70.1	13.0	16.9	<0.0001

* indicates Fisher Exact test was used, otherwise test was conducted with a Chi Square

Table 5. Percentage of respondents who believe that a specific level of government represents Agricultural stakeholders water needs and concerns best

Government Level	Agricultural Stakeholders	Specialists
County	83.1	36.2
State	13.6	37.7
Federal	3.4	26.1

$p < 0.0001$

Table 6. Percentages of stakeholders who believe that government should be given three different levels of additional power

Agricultural Stakeholders			Non-Agricultural Stakeholders			Specialists		
None	Some	A Lot	None	Some	A Lot	None	Some	A Lot
Federal (p = 0.2785)								
81.7	13.3	5.00	69.2	28.9	1.9	73.3	24.0	2.7
State (p = 0.0195)								
51.7	36.7	11.7	58.9	32.1	8.9	30.7	52.0	17.3
County (p = 0.9412)								
26.7	31.7	41.7	32.8	31.0	36.2	30.7	33.3	36.0

* indicates Fisher Exact test was used, otherwise test for equality of distribution of the three groups was conducted with a chi-square. Table entry as a percentage of respondents in that group selecting that response.

Figure 1. Location and land use of Lincoln Lake watershed in Arkansas