

***ECOLOGICAL ATTITUDES OF FARMERS AND ADOPTION
OF BEST MANAGEMENT PRACTICES***

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ABSTRACT

This paper reports on a study of Best Management Practices (BMPs) adoption by sugarcane producers in Louisiana and factors that influence producer decisions to adopt BMPs. A mail survey collected data on ecological views of sugarcane producers and their adoption of BMPs. Ecological views are measured using the New Ecological Paradigm Scale and additional survey questions on producers perceptions regarding agricultural nonpoint source pollution. Results show that producers may currently be in compliance with federal guidelines, but not meet more rigorous standards. Ecological views of producers suggest the need for producer education programs on BMPS and benefits to the environment.

INTRODUCTION

The Clean Water Act (CWA) [8], as amended in 1987, requires all States to develop policies and mechanisms to control nonpoint sources of pollution. Section 319 requires that States address nonpoint pollution by assessing nonpoint source pollution problems and causes within the State, adopting management programs to control the nonpoint source pollution, and implementing the management programs.

The Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) [9] require that each state participating in the Coastal Zone Management Act, including Louisiana, submit a Coastal Nonpoint Pollution Control Program (CNPCP) to the Secretary of Commerce and the U.S. Environmental Protection Agency for approval. The program must include enforceable policies and mechanisms to implement the applicable requirements of the Coastal Nonpoint Pollution Control Program of the State required by section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990.

The State of Louisiana is applying a voluntary approach to the implementation of the Louisiana Coastal Nonpoint Pollution Control Program (CNPCP). The State has developed a statewide comprehensive program that addresses the requirements of both Federal Acts by using enforcement of existing State laws to correct for violations when they occur. For agriculture, the program includes the establishment of a water quality monitoring system and the voluntary adoption of Best Management Practices (BMPs).

Current levels of BMP adoption should be determined to establish a benchmark for future compliance evaluation. Factors that influence adoption of BMPs need to be identified. Based on current levels of adoption and factors influencing adoption decisions, appropriate education tools need to be developed and implemented.

OBJECTIVES

This study targets sugarcane production in Louisiana. Twelve of the 21 parishes (counties) included in the study are in the designated Coastal Zone area of the state. The remaining parishes are in watersheds draining into the region. Objectives of the study include establishing a baseline of BMP adoption, analysis of factors that influence BMP adoption, and recommendations on appropriate actions to increase rates of BMP adoption.

DATA COLLECTION

Parish extension agents identified 943 sugarcane producers in the state. Of the 943 questionnaires mailed, a gross total of 307 surveys were returned, giving an overall response rate of 32 percent. A total of 84 returned questionnaires were discarded as incomplete. A net total of 223 responses were used in the empirical analysis, for a net response rate of 24 percent. The survey was conducted in January-March 1999.

The investigator-constructed questionnaire included eight sections. The survey questionnaire was designed to account for the determination of: which BMPs are currently being used in sugarcane production in Louisiana; factors affecting farmer's willingness to adopt environmentally desirable BMPs; educational and technical assistance needs to improve adoption rates and efficiency; and the impact of cost-sharing programs on the adoption of environmentally effective BMPs.

CURRENT ADOPTION OF BMPS

One of the objectives of this study was to determine the current adoption level of BMPs in the production of sugarcane in Louisiana. In its Guidance for Coastal Nonpoint Source of Pollution Control [13], EPA defines the following 'management measures' for agriculture: Erosion and Sediment Control; Confined Animal Facility; Nutrient Management; Pesticide Management; Livestock Grazing; and Irrigation. Expert opinion and relevant literature indicates that for sugarcane production in Louisiana, the management measures of importance are: Erosion and Sediment Control; Nutrient Management; and Pesticide Management.

For each of these management measures, EPA describes a series of 'management practices.' These practices are representative of the kind of practices that can be applied successfully to achieve the management measures. EPA also states that "[w]hile State programs are required to specify management measures in conformity with this guidance, State programs need not specify or require the implementation of the particular management practices described in this document [the guidance]." It adds that "as a practical matter, however, EPA anticipates that the management measure typically will be implemented by applying one or more management practices appropriate to the source, location, and climate" [13].

Both EPA and scientists at the Louisiana State University Agricultural Center based their review of environmentally desirable practices on the practices defined by the Natural Resource Conservation Service (NRCS). The adoption of these practices is the major concern of this research. Four management practices are defined for the Erosion and Sediment Control Management Measure. Three specific

management practices are defined for the Nutrient Management Measure. Four management practices are defined for the Pesticide Management Measure.

For the 11 practices included in this study, the current rates of adoption were as indicated in Table 1. EPA has stated that to comply with the requirements of the Coastal Nonpoint Pollution Control Program, each management measure will have to include at least one management practice. Under this scenario, the proportion of responding farmers that will be in compliance with that requirement were: 92 percent for the soil erosion and sediment control management measure; 92 percent for the nutrient management measure; and 95 percent for the pesticide management measure.

Some of the management practices included in the study were considered by farmers to be standard production practices. Given the growing possibility that the EPA requirements may be more stringent in the future, two other scenarios were evaluated in the empirical analysis. To that end, the descriptive statistics presented in Table 1 indicate that if sugarcane producers were required to implement at least two practices for each management measure, the proportion of farmers already doing so were: 82 percent for the soil erosion and sediment control management measure; 69 percent for the nutrient management measure; and 86 percent for the pesticide management measure.

If the requirement was for at least three practices per management measure, the proportions are: 53 percent for the soil and sediment control management measure; 12 percent for the nutrient management measure; and 48 percent for the pesticide management measure.

ANALYSIS OF ATTITUDES

Neoclassical economic analysis of choice is based on the theory of utility maximization. However, a person's utility is affected not only by his or her consumption of physical commodities but also by psychological attitudes, peer group pressures, personal experiences, and the general cultural environment [20]. Neoclassical economics, however, usually holds constant those other things that affect behavior [20].

For practical purposes, the psychological reaction to changes in constraints is not something we can readily observe. We are not able to read people's minds. In order to be useful, we must state economic postulates in terms of actions that we can observe, so that we can derive empirically refutable propositions [24].

Attitude is an abstract term derived from the Latin *aptus* that signifies >fitness= or >adaptedness=, and connotes a subjective or mental state of preparation for action. Given the fact that attitudes are always directed toward some object, it may be defined as a state of mind of the individual toward a value. Values are social in nature, they are objects of common regard to socialized men. Social values are created by the attitudes that are common to many men, and these attitudes in time, depend upon pre-existing social values [3].

Attitude is also defined as an implicit response which is anticipatory and mediating in reference to patterns of overt responses, which is evoked by a variety of stimulus patterns as a result of previous learning or of gradients of generalization and discrimination. It is cue- and drive- producing, and it is socially significant in the individual's society [7].

TABLE 1.
PERCENT OF RESPONDENTS IMPLEMENTING SELECTED BMPs, LOUISIANA SUGARCANE BEST MANAGEMENT PRACTICE ADOPTION STUDY.

Management Measures	Management Practices	Explanation	% Adoption	% Compliance - One Practice	% Compliance - Two Practices	% Compliance - Three Practices
Soil Erosion and Sediment Control	SSCP1	Land smoothing, precision leveling, and/or row arrangement.	75	92	82	53
	SSCP2	Use of either succession planting or fallow acreage with a cover crop (such as wheat, soybeans or others).	28			
	SSCP3	Delay stubble breakout and maintain crop residue (30% or more) through the winter months.	72			
	SSCP4	Use drop pipes or other grade stabilization structures to reduce erosion.	67			
Nutrient Management	NMP1	Determine fertilizer applications based on soil testing and expected yields.	88	92	69	12
	NMP2	Use any of the following fertilization practices: split application of nutrients, banded application, slow-release fertilizers.	72			
	NMP3	Utilize alternate sources of nutrients (manure, cover crops, sludge, or any other organic matter).	13			
Pesticide Management	PMP1	Base chemical applications (insecticides, herbicides) on economic thresholds as determined by field scouting.	85	95	86	48
	PMP2	Use of a containment facility for mixing, loading and storing farm chemicals.	37			
	PMP3	Calibrate spray equipment before each use.	90			
	PMP4	Precise application of chemicals using computer sensing to control flow rates, radar speed determination, and/or electrostatic applicators.	28			

ATTITUDES AND BEHAVIOR

In considering the relationship between attitudes and behavior, some other relationships are to be considered. There is fairly conclusive evidence that an individual's attitude toward any object is a function of his or her beliefs about that object and the evaluative aspects of those beliefs. There is also enough evidence that there is a stable and high correlation between attitude and behavioral intentions. Behavioral intentions are to be considered, however, as being independent from attitude [14].

Attitudes are a fundamental determinant of behavior, but not the only one. Theory identifies the basic determinants of behavior to be: a) attitudes toward the behavior; b) normative beliefs, both personal and social; and c) motivation to comply with the norms. Other variables are said to influence behavior, but they operate indirectly by influencing any of these three basic determinants. The weights of the three major determinants may vary with the type of behavior being considered and they may also vary across individuals. Outside variables may be related to the basic determinants of behavior, but they may be unrelated to the actual performance of a given behavior [14].

An individual's attitude toward a stimulus is related to his or her behavior with respect to that object. It may also be expected that an individual's attitude toward a given stimulus would influence his motivation to comply with a given norm. And, finally, variations in the situation may influence one or more of the primary determinants of behavior [14].

PRODUCER ATTITUDES

Several factors are hypothesized to affect the adoption of BMPs. Although no specific work has been done about factors affecting the adoption of BMPs within the context of specific regulation as the one enacted in CZARA, numerous studies have been done in terms of adoption of soil conservation practices and technology adoption. The development, implementation, and evaluation of any nonpoint source (NPS) pollution control program should include analysis of factors that influence farm operators' knowledge, attitudes, and behavior.

Table 2 presents a summary of statistics for institutional variables included in this study. Institutional factors that may have an impact on the decision to adopt or not adopt BMPs were evaluated through several different variables. Awareness of legislation related to improving water quality was assessed through two questions. One question asked whether the respondent was aware of the Coastal Nonpoint Pollution Control Program as specified in the Coastal Zone Management Act (ACZMA), to which only 44 percent responded positively, leaving a significant 56 percent unaware of the existence of such legislation. The second question aimed to determine awareness of the Clean Water Act (ACWA), to which 65 percent responded positively.

**TABLE 2
SUMMARY STATISTICS FOR INSTITUTIONAL VARIABLES, LOUISIANA SUGARCANE BEST MANAGEMENT PRACTICE ADOPTION STUDY.**

Variable	Explanation	Mean	Standard Dev.	Minimum	Maximum	Observations
ACZMA	Awareness of the Coastal Nonpoint Pollution Control Program as specified in the Coastal Zone Management Act.	0.44	0.50	0	1	223
ACWA	Awareness of efforts to control nonpoint sources of water pollution through the Clean Water Act.	0.65	0.48	0	1	223
HBMPT	Have heard the term Best Management Practices (BMPs).	0.65	0.48	0	1	223
BMP1WQ	Thinks the use of BMPs would improve the quality of water.	0.78	0.41	0	1	148
TMES	Number of times farm operator met with extension service personnel or attended educational programs sponsored by the extension service during the last year.	3.38	4.29	0	36	223
TAGM	Number of times farm operator attended grower meetings during the last year.	2.57	1.90	0	15	223
PCS	Participation in cost-sharing programs for any of the agricultural practices that have had this option.	0.63	0.48	0	1	223
ARWQ	Thinks agriculture reduces the quality of water coming off farmland.	0.38	0.49	0	1	223

Respondents were also asked whether they have ever heard the term Best Management Practices (HBMPT), to which 65 percent indicated yes. An interesting result was that out of those who had heard about Best Management Practices, 78 percent indicated that they believed that the use of Best Management Practices for sugarcane would improve the quality of water when compared to conventional production practices (BMPIWQ).

Results of the survey indicated that respondents met with extension service personnel or attended educational programs sponsored by extension personnel services (TMES) an average of 3.38 times during 1998. Respondents also indicated that they attended an average of 2.57 grower meetings (TAGM) in the same period.

Participation in cost-sharing programs was an important institutional factor, with 63 percent of the respondents indicating that they had participated in cost-sharing programs (PCS) for at least one of the practices that had offered that option in the study area. Expert opinion indicated that the following practices have had cost-sharing programs: land smoothing, precision leveling, and/or row arrangement; use of drop pipes or other grade stabilization structures to reduce erosion; use of alternative sources of nutrients (manure, cover crops, sludge, or any other organic matter); and, use of a containment facility for mixing, loading and storing farm chemicals. The assumption is that cost-sharing participation in at least one practice may have an impact on the adoption of other practices.

Respondents were also asked if they believe that agriculture reduces the quality of water coming off farmland (ARWQ). It was interesting to see that only 38 percent of the respondents think agriculture affects water quality. This appears to conflict with the response given to the BMPIWQ question above, where 78 percent of respondents agreed that BMPs improve water quality.

THE NEW ECOLOGICAL PARADIGM SCALE (NEPS)

Economics, as a science, is interested in explanations and predictions [24]. Economists assume that individuals, in their various roles, make those choices that are most favorable to them. Individuals undoubtedly derive utility from >doing good= [20]. We know a person is serious when he or she does something that entails a personal cost to him or her. That is why >actions speak louder than words= [24].

In that vein, A[t]here is evidence of a paradigmatic shift in the orientations of Americans toward the physical environment ... a recent environmental quality movement has spawned an alternative, ..., set of beliefs and values [1]. This movement has called for a >New Environmental Paradigm= whose orientations assert the desirability of restricting growth, protecting the integrity of ecosystems, and a more harmonious relationship between humans and nature [1]. Perceptions and expectations of environmental benefits have widened, and there is ever-increasing debate by larger segments of society about how natural resources should be managed [12].

In 1978, Riley Dunlap and Kent Van Liere acknowledged that the NEP appeared to have gained considerable popularity in academic and intellectual circles, as well as among many college students, but little had been done to determine the extent to which the public accepted the content of the NEP and to develop a measure of the New Paradigm. Consistent with that concern, Dunlap and Van Liere

proposed a measuring instrument, called the New Environmental Paradigm Scale (NEPS) [10].

The NEPS was extensively used [2; 4; 5; 6; 17; 18; 19; 21; 23; 25; 26] and criticized [1; 12; 15; 16; 22]. Among the criticisms, it was recognized that there was a flaw in the original scale as only 4 of the 12 items were worded in an anti-NEP direction, and all four focused on anthropocentrism or the belief that nature exists primarily for humans to use and has no inherent value of its own [11].

In 1992, Dunlap et al [11] addressed the imbalance in the direction of the wording of items in the original scale, and broadened the scale's content. They proposed a new and improved instrument called the New Ecological Paradigm Scale. The new label on the scale is based on broad ecological (as opposed to narrower, more specific and less systemic environmental) problems facing the modern world [11].

Five potential facets of an ecological worldview were analyzed in the new Scale: the reality of limits to growth, anti-anthropocentrism, the fragility of nature's balance, rejection of exemptionalism, and the possibility of an eco-crisis or ecological catastrophe. Three items were designed for each of these facets. Eight of the fifteen items were worded in such a way that agreement with them will indicate a pro-ecological view, and the other seven items were worded so that disagreement indicated a pro-ecological worldview. The revised set of 15 items exhibit a good deal of internal consistency, and because the new NEP Scale is related to a wide range of ecological attitudes and behaviors, it possesses predictive validity [11].

NEPS RESULTS

Table 3 presents a summary of the responses for the environmental attitudinal variables included in the current study. The average score was 46 (out of a possible 75) with a standard deviation of 8.88. That clearly indicates an average position in the middle of the scale, which for interpretation purposes could mean that sugarcane producers tend to be neutral about the issues presented to assess that particular matter. However, individual analysis per item yielded further implications, as discussed in the following paragraphs.

Table 3 presents a more detailed description of the responses to the questions on the NEP scale. An average of 22 percent of the respondents indicated they were unsure about the issues that were presented in each item. For a simplified interpretation of results in Table 3, responses under both *Strongly agree* and *Mildly agree* were added together, as well as responses under *Strongly disagree* and *Mildly disagree*. That is, strong and mild pro-ecological attitudes were considered together, as well as strong and mild anti-ecological attitudes. In only 2 of the 15 statements did a greater proportion of respondents express a pro-ecological view (Statements 8 and 15). In the remaining 13 statements a greater proportion of responses were against ecological positions.

TABLE 3. FREQUENCY DISTRIBUTIONS (PERCENT) FOR THE NEW ECOLOGICAL PARADIGM SCALE STATEMENTS¹, LOUISIANA SUGARCANE BEST MANAGEMENT PRACTICE ADOPTION STUDY.						
		SA	MA	U	MD	SD
1	We are approaching the limit of the number of people the earth can support.	16.67	15.28	27.31	23.61	17.13
2	Humans have the right to modify the natural environment to suit their needs.	8.80	33.80	18.06	23.61	15.74
3	When humans interfere with nature it often produces disastrous consequences.	6.94	18.98	16.20	34.72	23.15
4	Human ingenuity will ensure that we do NOT make the earth unlivable.	18.98	36.11	27.78	11.11	6.02
5	Humans are severely abusing the environment.	12.50	27.31	14.81	32.41	12.96
6	The earth has plenty of natural resources if we just learn how to develop them.	41.20	36.57	11.57	8.80	1.85
7	Plants and animals have as much right as humans to exist.	13.43	20.83	10.65	21.76	33.33
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations.	6.48	18.98	27.78	31.48	15.28
9	Despite our special abilities humans are still subject to the laws of nature.	0.93	3.24	11.57	37.96	46.30
10	The so called “ecological crisis” facing humankind has been greatly exaggerated.	15.74	32.41	36.11	12.96	2.78
11	The earth is like a spaceship with very limited room and resources.	12.04	25.93	22.22	30.56	9.26
12	Humans were meant to rule over the rest of nature.	18.98	26.39	17.13	21.76	15.74
13	The balance of nature is very delicate and easily upset.	4.63	16.20	19.91	38.89	20.37
14	Humans will eventually learn enough about how nature works to be able to control it.	9.26	20.37	26.85	25.93	17.59
15	If things continue on their present course, we will soon experience a major ecological catastrophe.	12.04	27.31	35.19	16.67	8.80
¹ Question wording: “Listed below are statements about the relationship between humans and the environment. For each one, please indicate (by marking the appropriate column) whether you STRONGLY AGREE (SA) , MILDLY AGREE (MA) , are UNSURE (U) , MILDLY DISAGREE (MD) or STRONGLY DISAGREE (SD) with it”						

For Statement 8, 47 percent of the respondents had a pro-ecological position, while 25 percent had an anti-ecological position. For Statement 15, 39 percent of the responses were in agreement with pro-ecological positions, while 25 percent supported anti-ecological views. The most striking anti-ecological opinions were found in responses to Statements 6 and 9, where 78 percent of respondents agreed with the statement that A[t]he earth has plenty of natural resources if we just learn how to develop them@ and 84 percent disagreed with the statement that A[d]espite our special abilities humans are still subject to the laws of nature.

Statements 1, 6, and 11 also showed a greater percentage against ecological views. It was clear that producers in this case rejected the proposition that there are limits to growth. Responses to Statements 4, 9, and 14 imply that most producers believe that humans are exempt from the constraints of nature because of their intellectual and other talents. More respondents hold an anthropocentric position, since a greater proportion expressed that view in Statements 2, 7, and 12.

As indicated before, through Statement 8 respondents expressed some concern about the fragility of nature=s balance. However, this was offset by Statements 3 and 13 having a majority in favor of a rejection of the idea of the fragility of nature=s balance. By the same reasoning, even though a greater percentage of respondents accepted the possibility of an eco-crisis or ecological catastrophe through their answer to Statement 15, this was again offset by their responses to Statements 5 and 10.

Two major issues arise from the analysis of the NEPS: 1) the average score reflects, as indicated before, an unsure position with respect to the aggregation of all statements in the scale; and 2) the analysis in the preceding paragraphs, based on results presented in Table 3, indicated that when statements were analyzed individually, sugarcane producers in Louisiana were likely to not hold pro-ecological views.

SUMMARY AND CONCLUSIONS

The voluntary BMP adoption program used by Louisiana to meet the requirements of the Coastal Nonpoint Pollution Control Program and the Clean Water Act needs to continue to demonstrate it's effectiveness in terms of adoption rates and improved water quality. BMP's that have proven to be economically effective in the short run have been readily adopted by producers. The challenge will be the promotion of practices that have long term economic and environmental benefits.

This study investigated the adoption of three types of management measures in the EPA guidance most relevant to sugarcane production in Louisiana: Erosion and Sediment Control; Nutrient Management; and Pesticide Control. Within each of these management measures are recommended management practices. This study found that under current requirements of adoption of at least one management practice, over 90 percent of the producers in the study would be in compliance with EPA guidelines. However, from a practical standpoint, producers can expect compliance requirements to increase over time. As the required number of management practices within a management measure increased, compliance decreased. The decline was most dramatic for the nutrient management measure, falling from 92 percent compliance with one management practice to only 12 percent when the requirement was set at three management practices.

The study survey included questions to determine the level of awareness producer have of federal law on water quality and agriculture. While almost two-thirds (65 percent) of the respondents knew of the Clean Water Act, less than half (44 percent) were aware of the CNPCP. Of those respondent who had heard of the term “best management practices” (65 percent), over three-quarters (78 percent) believed BMPs would improve water quality. However, only 38 percent of those completing the survey acknowledged that agriculture affects water quality.

The New Ecological Paradigm Scale is an accepted approach to measuring attitudes toward the environment. Sugarcane producers responding in this study held strong beliefs that man is capable of overcoming constraints of nature through intellect and other talents. Seventy-eight percent agreed with a statement that “...earth has plenty of natural resources if we just learn how to develop them.” The same percentage disagree with the statement “Despite our special abilities humans are still subject to the laws of nature.”

The attitude responses presented here imply that much needs to be done to convince producers that agriculture plays a role in reduced water quality. The NEPS responses indicate that this set of producers believe that we can increase productivity of our natural resources without endangering the balance of nature. How do we meet the regulatory requirements under these circumstances?

The approach of the LSU AgCenter is to increase awareness and create educational opportunities. Effective education avenues include:

- Working closely with producer groups
- Increasing the number of contacts producers have with university experiment station and extension personnel
- Implementing a Master Farmer program that includes training and certification of producers in BMP education.

A working relationship already exists between sugarcane producers and university faculty. More targeted educational programs directed through the producer organizations is needed. In 2002 the LSU AgCenter established a statewide Master Farmer program for certification in BMP practices. In 2003, state legislation made the Master Farmer program the approved method demonstrating voluntary compliance with water quality requirements.

These education efforts should, over time, influence producer attitudes toward the role agriculture plays in water quality. However, as the results of this study illustrate, the education task ahead is significant.

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