

## **An Examination of Pollution Prevention In Montana Secondary Agricultural Education Laboratories**

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### **Abstract**

This study was designed to determine what waste management and pollution prevention practices, were being applied by Montana agricultural educators in the classroom, laboratory and field settings. When practices were not applied, barriers to implementation were examined. An attempt was also made to measure general perceptions of environmental issues and pollution prevention.

A survey titled "Pollution prevention in Agricultural Education Laboratories and Field Areas" was administered to 73 Montana Agricultural Education Programs. A final response rate of 56.2% was obtained. Anonymity was protected throughout the course of the study. The data presented in this article were part of a larger study; for the purpose of this article, focus will be kept on the three most utilized laboratory areas, (Mechanics, Wood Lab, and Green House/Farm Plot), perceptions, and barriers to pollution prevention. All data acquired from the survey are available from the author.

Results of the study found that deficiencies were identified with current practices in pollution prevention and waste management by Montana agricultural educators. Lack of knowledge, or need for further education was the primary barrier to practice and improvement of pollution prevention identified by survey respondents. Agricultural educators in surveyed in Montana, had positive perceptions of pollution prevention and appear willing to improve their practices in pollution prevention and waste management.

The participants in this study indicated a need for education in pollution prevention specific to agricultural teaching laboratories and field areas. Agricultural educators in Montana are interested in pursuing this issue. Data obtained through this study may also be pertinent in other areas of vocational education where similar teaching or research facilities are maintained.

It is recommended that a pollution prevention education or training program, specific for agricultural education, should be developed as soon as possible. It should focus on source reduction of waste, management of unavoidable waste and consideration to proper facilities planning and management. Agricultural educators themselves should be as involved as possible in the development of pollution prevention training and education. Such information should become part of a holistic pollution prevention resource for educational institutions including all traditional, academic and vocational (agriculture included) teaching areas.

## Introduction/Theoretical Framework

Pollution prevention is an idea, conceived in the early 1980's, and born into national policy with the passing of the Pollution Prevention Act of 1990. The pure concept of pollution prevention (P2) deals with source reduction of waste through use of alternate (better for human health and the environment) products, practices and processes. The passing of this act helped create resources for research, education, technical assistance and development of policy and legislation.

The United States Environmental Protection Agency (EPA, 1990) summarized the multifaceted importance of practicing and teaching pollution prevention in educational settings by stating, "Reduction of pollutant emissions associated with research and educational activities is an important objective consistent with traditional environmental policy. More significantly, however, the adoption of waste minimization by the research and educational community carries with it a tremendous potential for designing pollution out of future industrial [or agricultural] processes right in the lab." Williams recognized agriculture's involvement in this arena, when he stated, "Production agriculture and agribusiness industries face, as well as contribute to, environmental concerns" (1993, p. 5).

Many schools have begun to examine their practices and take action in acting more responsibly as a whole institution in the areas of waste reduction, waste management and hazardous material management. Educators in science, especially chemistry, are examining the way they teach and conduct laboratory experiments (Collins, 1995). They are taking steps towards decreasing health risk to students, instructors and the environment by more effective management of chemicals, potential hazards and waste.

Agricultural educators and students already have an idea of how agriculture and the environment are related. In a survey conducted on the impacts of sustainable agriculture, agricultural educators and students recognized that sustainable agricultural practices involved or contributed to the following: better conservation of soil, greater management requirements, reduced use of chemicals, protection of groundwater, safer food and protection of wildlife and woodlands (Williams and Wise, 1997).

Williams supported the integration of sound environmental practices with agricultural education in 1993 when he stated, "If agricultural educators recognize these {environmental} concerns and teach their students how to develop solutions to these problems through the application of scientific principles, then the students, the agricultural industry, and the profession of agricultural education will all benefit (p. 5)."

A small percentage of research in agricultural education relates to environmental issues. Of 853 articles published in the Journal of Agricultural Education and papers presented at the National Agricultural Education Research Meetings from 1986 to 1996, only 18 dealt with what was categorized as "environmental" issues (Radhakrishna and Xu, 1997). That means only two percent of published research in these two venues were dedicated to environmental issues. Radhakrishna and Xu described environmental and sustainable agriculture topics as "emerging topics" (1997).

Bogo (1999), quoted former Tufts University dean, Anthony Cortese as saying, "If the students are learning in class about the environment and how to act responsibly, and the university through its buildings, its operations and investments is unsustainable, then they are

sending a very subtle but effective message that says ‘do what I say, not what I do’, practicing what they preach is extremely important” (p. 39). This idea also holds true in the high school setting, especially for agricultural education.

### **Purpose and Objectives**

This study was designed to determine what waste management and pollution prevention practices, were being applied by Montana agricultural educators in the classroom, laboratory and field settings. When practices were not applied, barriers to implementation were examined. An attempt was also made to measure general perceptions of environmental issues and pollution prevention. The specific objectives were:

1. To determine Montana agricultural educators’ current practices in pollution prevention and waste management;
2. To identify barriers to implementation of practices in pollution prevention by Montana agricultural educators;
3. To determine Montana agricultural educators’ perceptions of environmental issues and pollution prevention.

### **Methods/Procedures**

Descriptive research methodology was used to fulfill the objectives of this study. Potential individuals for the study population were identified through the Directory of Montana Agricultural Educators, maintained by the Agricultural Education Program at Montana State University. Seventy-three programs were listed in the directory. Participants were contacted by postcard prior to inclusion in the survey mailing. Every program on the roster was included in the mailing; therefore, this survey was a census (Gall, Borg and Gall, 1996).

The research instrument was a survey constructed with partial adherence to the Total Design Method (TDM) published by Dillman (1978). The survey instrument is a collection of questions which were developed from review of related literature, expert advice and prior use in other related surveys or audits. There were no distinguishing features on the survey instruments which could lead to identification of participants upon return. Identification of participants by name was solely voluntary.

The survey was constructed with a combination of questions using three and five point Likert-type scales, nominal scale and open ended format. Question format was chosen on appropriateness for the type of answer desired and to maintain the highest instrument validity. Further comments were encouraged at the end of the survey on any related topic or issue. These comments are available from the author.

Twenty pilot surveys were sent out to technology education instructors in Montana secondary schools. While this audience did not maintain all of the same teaching laboratories, many similarities did exist. This audience was encouraged to evaluate the survey for content and face validity. A survey draft was also administered to an expert panel, composed of a subject matter specialists, and two agricultural education professors (university level). Appropriate adjustments were made to the instrument in accordance with comments made by pilot audience

and expert panel.

A Cronbach's Alpha-Reliability Analysis was conducted using all Likert-type scale questions in the survey instrument on the final data. "For research purposes, a useful rule of thumb is that reliability should be at least .70 and preferably higher" (Franken and Wallen, 1996 p. 163). The Cronbach's Alpha-Reliability coefficient rating for this instrument was .78, therefore, the overall reliability of the survey was acceptable.

The data for this study were collected using a mailed survey instrument. A total of 73 surveys were mailed to agricultural educators in Montana secondary schools following a pre-survey post card. One e-mail reminder was transmitted and one follow up postcard mailed. Data from returned surveys were manually entered into spreadsheets where frequencies for all survey questions were calculated. Statistical analysis on early and late respondents, and reliability analysis was conducted in SPSS® 9.0 for Windows®.

Early and late respondents were examined for statistical difference by a t-test and a Mann-Whitney U test (Gall, Borg, and Gall, 1996). The hypothesis that there would be no difference was found between early and late responders, as no significant differences were found at the .05 level. Late responders were combined with early responders for the remaining data analysis. A final response rate of 56.2% was obtained.

## **Results/Findings**

Since not all total respondents answered each section of the survey, percentages throughout the results are representative only of the frequencies of a response to that single question. The total number of responses for each question is listed under "Frequency, Total" for that question in the table, or below the table when indicated by an asterisk. Due to the sensitive nature of this survey, and the perception by the population that some answers may be incriminating, anonymity was protected. This issue also may have led respondents to omit certain demographic data, which they felt may lead to their identification.

The data presented in this article were part of a larger study which collected data in the following ten areas: 1) Demographics, 2) Program information, 3) Agricultural and power mechanics laboratory, 4) Green house and farm plot, 5) Wood laboratory, 6) Metals/welding laboratory, 7) Animal confinement area, 8) Curriculum and classroom management, 9) Perceptions, and 10) Barriers to Pollution Prevention. For the purpose of this article, focus will be kept on the three most utilized laboratory areas, (Mechanics, Wood Lab, and Green House/Farm Plot), perceptions, and barriers to pollution prevention. All data acquired from the survey are available from the author.

### Agricultural or Power Mechanics Laboratory Area

Thirty-nine respondents answered questions in this section. They identified a variety of wastes generated through the activities of their agricultural or power mechanics laboratory. Four wastes were generated by over fifty percent of respondents; they are as follows: Oil frequency =35 (89.7%), Used oil filters frequency =33 (84.6%), Cleaning solvents frequency =27 (69.2%) and Antifreeze frequency =24 (61.5%). Waste diesel or gasoline was acquired by 18 (46.1%) respondents and waste transmission fluid was acquired by 17 (43.5%) respondents. Wastes

acquired by the smallest number of respondents were: Batteries frequency =9 (23.0%), Brake fluid frequency =8 (20.5%), Tires frequency =5 (12.8%) and other waste frequency =2 (5.1%). Table 1 delineates these data.

Table 1. Number of programs who acquire the following wastes through teaching activities in agricultural or power mechanics laboratories.\*

Type of waste	frequency	percent
Oil (O)	35	89.7
Used oil filters (OF)	33	84.6
Cleaning solvents (CS)	27	69.2
Anti-freeze (AF)	24	61.5
Diesel or gasoline (D or G)	18	46.1
Transmission Fluid (TF)	17	43.5
Batteries (B)	9	23.0
Brake fluid (BF)	8	20.5
Tires (T)	5	12.8
Other	2	5.1

\* Percentage of agricultural or power mechanics laboratories acquiring said waste based on 39 respondents to this portion of the survey.

Respondents of this section were asked to first indicate their level of awareness of recycling options and best disposal methods for the wastes identified in Table 1, and then to indicate how often those options and methods are utilized or practiced. Table 2 indicates responses to these questions with wastes being divided into two categories. Oil, transmission fluid, anti-freeze, brake fluid, diesel or gas and cleaning solvents were grouped together as engine fluid wastes. Out of 35 respondents to this question, 5 (14.3%) indicated they were very aware of recycling and best disposal methods for these wastes, 19 (54.3) said they were aware, and 11 (31.4%) were not aware. When asked if they practiced recycling or best disposal methods, 9 (25.7%) answered “Always”, 17 (48.6%) answered “Mostly”, 8 (22.9%) “Seldom”, and only 1 (2.8%) never practiced recycling or best disposal methods.

Awareness of recycling options and best disposal methods were not high with solid waste associated with the mechanics laboratory (batteries, tires and oil filters, and other). Six (17.6%) respondents out of 34 indicated they were very aware, 16 (47.1%) aware, and 12 (35.3%) said they were not aware of recycling options or best disposal methods for such waste. Level of practice of recycling options and best disposal methods for these waste, also noted in Table 2, is as follows: 7 (20.5%) respondents answered that they always practiced said options and methods, 11 (32.4%) “Mostly”, 11 (32.4%) “Seldom”, and 5 (14.7%) indicated “Never”.

Table 2. Level of awareness and practice of recycling options and best disposal methods for previously mentioned wastes in agricultural/power mechanics laboratories.

	Type of waste			
	O, TF, AF, BF, D or G, CS * (fluids)		B, T, OF, Other (solids)	
Level of awareness	Frequency	Percent	Frequency	Percent
very aware	5	14.3	6	17.6
aware	19	54.3	16	47.1
not aware	11	31.4	12	35.3
Total	35	100.00	34	100.00
Level of practice	Frequency	Percent	Frequency	Percent
always	9	25.7	7	20.5
mostly	17	48.6	11	32.4
seldom	8	22.9	11	32.4
never	1	2.8	5	14.7
Total	35	100.00	34	100.00

\* See Table 1 for explanation of abbreviations.

Where engine fluid wastes were concerned, respondents were asked to indicate whether they practiced safe storage techniques and utilized spill containment methods. The following data are also available in Table 3. Of 35 respondents to these questions, 32 (91.4%) indicated that they used sealed containers or spill prevention in storage areas. Three (8.6%) respondents indicated that they did not. Only 16 (45.7%) respondents indicated some sort of spill containment method was used in the work area, the remaining 19 (54.3%) indicated that no such methods were used.

Table 3. Practice of safe storage methods and spill containment for engine fluid wastes.

	Use of sealed containers and spill prevention in storage area		Use of spill prevention and spill containment in work area	
	Frequency	Percent	Frequency	Percent
Yes	32	91.4	16	45.7
No	3	8.6	19	54.3
Total	35	100.00	35	100.00

Green House and or Farm Plot

Respondents answered a bank of questions related to storage methods and practices of pesticides and agricultural chemicals. Data related to these questions are presented in Table 4. Twelve of 21 (57.1%) respondents maintained an inventory of pesticides on school property, while the remaining 9 (42.9%) did not. Eighteen of 20 (90.0%) respondents maintained this inventory in a secure area, safe from water penetration, while 2 (10.0%) did not. Seventeen of 20 (85.0%) indicated that their pesticides were well labeled and identified, while 3 (15.0%) indicated otherwise. Of 16 respondents to the question concerning routine calibration of spraying equipment, 10 (62.5%) indicated that they regularly calibrated sprayers, while 6 (37.5%) indicated they did not engage in such activity.

Table 4. Occurrence of proper practices in pesticide storage, and handling in greenhouses and/or farm plots.

	Pesticide inventory maintained on property		Use secure storage area safe from water penetration		Pesticides well labeled and identified		Regular calibration of sprayers	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	12	57.1	18	90.0	17	85.0	10	62.5
No	9	42.9	2	10.0	3	15.0	6	37.5
Total	21	100.00	20	100.00	20	100.00	16	100.00

Further questioning into proper pesticide application and handling techniques revealed (also shown in Table 5) that out of 21 respondents, 8 (38.1%) always applied pesticides to deal with targeted organisms, 8 (38.1%) mostly followed this trend, while 4 (19.0%) seldom did and 1 (4.8%) never applied pesticides for target organisms only. Of 21 respondents, 13 (61.9%) indicated that they always followed recommended application rates, 8 (38.1%) indicated they mostly followed recommended application rates and no one answered seldom or never. When asked if pesticides were mixed on a pad that would contain spills and prevent contamination of soils or water resources, 5 out of 19 (26.3%) indicated they always used such an area for mixing, 6 (31.6%) mostly did, 6 (31.6%) more indicated they seldom use of such an area, and 2 (10.5%) never.

Table 5. Level of practice of proper pesticide application and handling techniques.

Level of practice	Apply for target organisms only		Follow recommended application rates		Use spill containment measures while mixing	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Always	8	38.1	13	61.9	5	26.3
Mostly	8	38.1	8	38.1	6	31.6
Seldom	4	19.0	0	0.0	6	31.6
Never	1	4.8	0	0.0	2	10.5
Total	21	100.00	21	100.00	19	100.00

Twenty-one persons responded to the question concerning the use of personnel safety measures, such as clothing, gloves, and eye wear. Table 6 describes these data. Of those 21 respondents, 12 (57.1%) always made use of such measures, 7 (33.3%) mostly did, 2 (9.6 %) seldom took such measures, and no one indicated never. Sixteen of 31 (51.6%) respondents always store chemicals in original containers, 14 (45.2%) answered mostly, no respondent indicated seldom, while 1 (3.2%) indicated chemicals were never stored in original containers. None of 21 respondents indicated that they always compost old plant material, 8 (38.1%) indicated they mostly did, 9 (42.9%) indicated they seldom did, and 4 (19.0%) never composted old plant material.

Table 6. Level of practice of recommended techniques related to agricultural chemical safety, storage and alternative techniques (compost).

Level of practice	Take recommended personal safety measures (clothing, gloves, eye wear)		Store chemicals in original containers		Use old plant material for compost	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
always	12	57.1	16	51.6	0	0.0
mostly	7	33.3	14	45.2	8	38.1
seldom	2	9.6	0	0.0	9	42.9
never	0	0.0	1	3.2	4	19.0
Total	21	100.00	31	100.00	21	100.00

Twenty respondents answered the first question concerning awareness of recycling options and proper disposal methods for agricultural chemical containers (see Table 7). Three (15.0%) respondents indicated they very aware of such options and methods, 13 (65%) indicated they were just aware, and 4 (20%) were not aware. Three respondents of 21 (14.3%) indicated they always recycled or properly disposed of chemical containers, 10 (47.6%) mostly used such options or methods, 5 (23.8%) indicated seldom, and 3 (14.3%) indicated recycling options or

proper disposal methods were never used.

Table 7. Level of awareness and practice of recycling and proper techniques in agricultural chemical and chemical container disposal.

Recycling options and proper disposal methods for agricultural chemicals and empty chemical containers		
Level of awareness	Frequency	Percent
very aware	3	15.0
aware	13	65.0
not aware	4	20.0
always	3	14.3
mostly	10	47.6
seldom	5	23.8
never	3	14.3
Total	41	200.00

#### Wood Laboratory

The following data are also available in Tables 8 and 9. All 30 (100.0%) respondents to the wood laboratories section of the survey indicated that they had surplus paint in their laboratories, 25 (83.3%) indicated that possessed surplus stains, 23 (76.6%) possessed surplus solvents and strippers, and 3 (10.0%) indicated that they also possessed other similar materials. Thirty-four responses were made to the question concerning storage of the previously mention wood finishing chemicals on site. Thirty-three respondents (97.0%) indicated that they did store such chemicals, while 1 (3.0%) indicated such chemicals were not stored on school property for more than a few days. Twenty-three of 33 respondents (69.7%) indicated that such chemicals were stored in a fire retardant cabinet, 10 (30.3%) indicated such chemicals were not. Out of 29 respondents, 20 (69.0%) indicated that they were aware sawdust could be composted, the remaining 9 (31.0%) were not aware.

Table 8. Types of waste generated in wood laboratory.\*

Type of waste	Frequency	Percent
Paint (P)	30	100.0
Stain (ST)	25	83.3
Solvents/strippers (SO)	23	76.6
Other	3	10.0

\*Percentages based on 30 respondents who maintain wood laboratories in their program.

Table 9. Occurrence of proper storage technique of wood finishing chemicals and awareness of alternative disposal method (compost) for sawdust.

	Store P, ST, SO, or other waste on property		Paints and solvents stored in fire retardant cabinet		Aware clean sawdust can be composted	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	33	97.0	23	69.7	20	69.0
No	1	3.0	10	30.3	9	31.0
Total	34	100.00	33	100.00	29	100.00

When asked if they were aware of proper disposal techniques for wood finishing chemicals, also as seen in Table 10, 3 (9.0%) of 34 total respondents indicated that they were very aware of proper methods, 16 (47.0%) indicated they were aware, and 15 (44.0%) answered not aware. Next, respondents indicated the level of practice of proper disposal for wood finishing chemicals. Thirty-three responses were made for this question. Four (12.5%) respondents always used proper methods, 6 (18.8%) mostly used proper technique, 14 (43.7%) seldom use proper methods, and 8 (25.0%) never use proper disposal methods for wood finishing chemicals.

Table 10. Level of awareness and practice of proper disposal techniques for wood finishing chemicals (paint, stain, solvents/strippers and other waste).

Recycling options and proper disposal methods for paint, stain, solvents/strippers and other wood shop chemical waste		
Level of Awareness	Frequency	Percent
very aware	3	9.0
aware	16	47.0
not aware	15	44.0
Total	34	100.00
Level of Practice	Frequency	Percent
always	4	12.5
mostly	6	18.8
seldom	14	43.7
never	8	25.0
Total	32	100.00

### Barriers to Pollution Prevention

Barriers to practice, or improved practice, of pollution prevention were addressed at the end of the survey, and the data presented in Table 11. Thirty-nine responses were recorded for this section, more than one answer was accepted per respondent. Thirty-three (84.6%) respondents indicated that increased knowledge could improve their pollution prevention, 10 (25.6%) indicated increased administrative support could improve their practices, 23 (58.9%) indicated new funds would improve pollution prevention practices, 12 (30.7%) listed increased community support as a barrier reducing factor, 28 (71.8%) indicated more community resources could help improve pollution prevention, and 5 (12.8%) answered “other.” Table 11 describes this data.

Table 11. Reduction in barriers to pollution prevention.

Reduction of barrier	Frequency	Percent*
Increased knowledge	33	84.6
Increased administrative support	10	25.6
New funds for implementation of more P2	23	58.9
Increased community support	12	30.7
More community resources**	28	71.8
Other	5	12.8

\*Percentages based on an Frequency of 39 respondents to this portion of the survey.

\*\* (recycling, special collections, outside assistance) These are waste management systems, not P2 in the strict definition.

### Perceptions of Environmental Issues in Agriculture

A measurement was made on the level of agreement with seven statements concerning concepts of agriculture’s relation to environmental responsibility and regulation, pollution prevention and waste management. Respondents answered using the following scale: Strongly agree (SA), Agree (A), Disagree (D), or Strongly disagree (SD). The question, frequency of responses and percentages all presented in Table 12.

Table 12. Level of agreement with statements concerning perceptions of waste management and pollution prevention in a broad agricultural setting.

Question		SA	A	D	SD	Total
The behavior of one person or group can have a significant affect on larger environments.	Freq.	19	22	0	0	41
	Percent	46.3	53.7	0.0	0.0	100.00
Agriculture is dependent on clean safe soil, air and water.	Freq.	27	14	0	0	41
	Percent	65.9	34.1	0.0	0.0	100.00
Agriculturalists are responsible for their own actions concerning the environment.	Freq.	20	18	0	1	39
	Percent	51.3	46.2	0.0	2.5	100.00
Monetary cost, time and labor are issues to be considered when making decisions which may affect	Freq.	4	33	3	1	41
	Percent	9.8	80.5	7.3	2.4	100.00
Considering the previous issues, it is still possible for agriculturalists to make environmentally responsible	Freq.	14	24	1	0	39
	Percent	35.9	61.5	2.6	0.0	100.00
Agriculturalists are currently doing enough to protect the environment and sustain their industry.	Freq.	0	18	21	0	39
	Percent	0.0	46.2	53.8	0.0	100.00
Agriculturalists are capable of policing themselves without intervention by the government and	Freq.	5	20	15	1	41
	Percent	12.2	48.8	36.6	2.4	100.00

### Conclusions, Recommendations, and Implications

Based on the analysis of quantitative data, and consideration for written comments by survey respondents, the following **conclusions** were drawn:

1. Deficiencies were identified with current practices in pollution prevention and waste management by Montana agricultural educators. The results indicate the most eminent are in the mechanics laboratory, greenhouses and farm/field plots, and in the wood laboratory.
2. Lack of knowledge, or need for further education was the primary barrier to practicing pollution prevention identified by survey respondents.
3. Agricultural educators in Montana had positive perceptions of pollution prevention. Most agreed that agriculturalists are responsible for their own actions concerning the environment and that the actions of few can have a wide effect.
4. Montana agricultural educators do have a basic knowledge or awareness of pollution prevention and proper waste management. On all questions dealing with awareness, over 50% of respondents indicated they were aware or very aware of the topic and practices associated with

that question. Re: tables 2, 7, and 10, dealing with awareness of recycling options and proper disposal techniques for mechanics laboratory waste, agricultural chemicals, and wood finishing chemicals.

The entire research process, including review of literature, collection and analysis of data, and consideration of comments made by survey respondents, committee members and others led the researcher to make the following **recommendations**:

1. A pollution prevention education or training program, specific for agricultural education, should be developed as soon as possible. It should focus on source reduction of waste, management of unavoidable waste and consideration given to proper facilities planning and management.

2. Agricultural educators themselves should be as involved as possible in the development of pollution prevention training and education.

3. Pollution prevention training should be made an integral part of college studies for those pursuing teaching degrees in agriculture. Pollution prevention should be part of career-long updates and re-certification programs for educators.

The data and written comments provided by this survey allowed the researcher to define the following **implications**:

1. Education on managing agricultural teaching laboratories in an environmentally responsible way should not only target instructors or educators. Students and administrators, while on opposite ends of the educational spectrum, are also integral components of successful pollution prevention initiatives being taken in the teaching laboratory.

2. Data obtained through this study may also be pertinent in other areas of vocational education where similar teaching or research facilities are maintained. Such research can also contribute to that which has already been done in other areas such as chemistry and biology education.

3. A potential exists for agricultural educators to receive reprimands, should a regulatory agency scrutinize current practices in waste management and pollution prevention.

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## **An Examination of Pollution Prevention In Montana Secondary Agricultural Education Laboratories**

### **A Critique**

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Everyone of us pollutes the environment each day, whether we think about it or not. In fact, human beings have been polluting the environment for longer than we can imagine. Yet, we live in a society today which is gravely concerned about the environment in which we live. As a result, Congress has passed policies concerning pollution prevention. Furthermore, a topic in the presidential election this year will focus on the environment and what we can do to improve the quality of the environment in which we live.

The purpose of this study was to determine what waste management and pollution prevention practices were being applied by Montana agricultural educators in classroom, laboratory, and field settings. In a day where there is much emphasis on environmental issues, this line of inquiry is most needed in the profession. The authors do an excellent job of presenting the introduction and theoretical framework for this study. The purpose and objectives are well defined and the methodological procedures are sound.

I would raise the following questions on the procedures and methods of the study. Was a five point Likert-type scale used in the study or was actually a four point Likert-type scale used? The procedures section of the study mentions a three and five point Likert-type scale while the tables in the results section indicates a four point Likert-type scale was used. Also, how was the reliability of the questionnaire determined? If there are different sections of the questionnaire that used different Likert-type scales, should not reliability coefficients be determined separately for each section? I noticed that only one reliability coefficient was reported. Does this reflect the true reliability of the survey instrument?

The results of the study were very interesting. I was amazed at the lack of awareness and practice agricultural education teachers has about recycling options. It is evident in Table 11 that increased knowledge can help make a difference in the lack or awareness and practice. How can the profession provide this knowledge? Do we need to integrate these concept into the undergraduate program or have professional development activities for teachers on a periodic basis?

I commend the authors for this line of inquiry. I hope the profession can make a difference in helping improve the environment in which we live and educating people to become more conscience about pollution prevention practices.