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STUDENTS' KNOWLEDGE OF AND EXPECTED IMPACT FROM SUSTAINABLE AGRICULTURE

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Abstract

Economically sound environmentally protective, and socially acceptable are the three widely advocated components of sustainable agriculture. The public expects farming to be socially and environmentally responsible, and farmers desire to farm within more responsible boundaries. Research is being conducted to identify agricultural practices that address all three components of sustainable agriculture and educational programs are being developed to disseminate the new knowledge. The purpose of this study was to determine high school agricultural education students' self-assessed knowledge of and expected impact from sustainable agriculture. The respondents were 386 agricultural education students from 31 Iowa high schools. Likert-type scales were used to measure knowledge and impact. Students rated themselves as having limited knowledge of sustainable agriculture practices, but the expected impact was high, especially for environmental and social aspects. Students' positive belief regarding the expected impact from sustainable agriculture provides a base upon which a curriculum can be developed to help students gain the knowledge needed to realize the potential they see in sustainable agriculture.

Theoretical Framework

The American food and fiber system has been described as a powerful industrial machine producing abundant food and robust exports. But cheap food and exports do not tell the whole story. The development and adoption of technologies for economic gain have frequently overlooked the environmental and social cost resulting from contemporary agriculture (Northwest Area Foundation, 1994). Hamilton (1999) advanced that sustainable agriculture has the potential to address both environmental and social needs of agriculture. "Sustainability must start from the ground up and agriculture is the place to begin. If food production systems . . . are not grounded on the principles of sustainability, our future is in doubt" (Hamilton, 1999, p. 6).

In response to growing environmental and social concerns, steps are being taken by the agricultural industry to develop and use more responsible practices. Many farmers share concerns about the future of the food and fiber industry and some are taking action to improve their operations. "Without abandoning the quest for efficiency, they are trying to farm within more responsible boundaries. They want a farm that is not only profitable, but durable. The kind of agriculture they aspire to is usually termed 'sustainable agriculture"' (Northwest Area Foundation, 1994, p. 2). One of the most comprehensive definition of sustainable agriculture was given in the 1990 Farm Bill:

> The term sustainable agriculture is an integrated system of plant and animal production practices having a site-specific application that will, over the long-term, satisfy human food and fiber needs; enhance the environmental quality and natural resources base upon which the agriculture economy depends; make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate natural biological

> cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole (U. S. Congress, 1990, p. 3).

The Experiment Station Committee on Organization and Policy (ESCOP) (1992) highlighted sustainable agriculture in its research agenda for the 1990s, describing it as a significant issue in agriculture and foremost in the minds of the U. S. public. Williams and Dollisso (1998) advanced that the discipline of agricultural education (teaching and learning in agriculture) should become "an active partner in achieving the goals of a sustainable agriculture industry.. . . " (pp. 54-55). Marshall and Herring (199 1) believed that sustainable agriculture should be integrated into the curriculum. Integrating the technical and scientific elements of sustainable agriculture would help upgrade the high school agricultural education curriculum to meet the needs of students preparing to enter the work force of the 21st century food and fiber system. (National Council for Agricultural Education, 1995).

Williams and Wise (1997) discover that even though high school agricultural education students were positive about the potential impact of sustainable agriculture, they do not fully understand how sustainable agriculture components fit together and relate to social goals such as quality water, safe food and preservation of natural resources. A better understanding of students' knowledge of and impact expected from sustainable agriculture would aid the development of teaching and learning initiatives in this area.

Purpose and Objectives

The purpose of this study was to assess students' thoughts on sustainable agriculture. The specific objectives were to: (1) determine student self-assessed knowledge of selected sustainable agriculture practices and (2) determine the impact expected from sustainable agriculture.

Methods and Procedures

The targeted population was all eleventh and twelfth grade students enrolled in agricultural education courses in Iowa during the 1998 Spring semester. Ten schools were randomly selected from each of the six FFA districts in Iowa to participate in the study. Stratified random sampling was used to ensure proportional representation from each region of the state. The agricultural education teachers in these 60 schools were asked to administer the instrument to students in agricultural education classes serving primarily juniors and seniors. However, only 3 1 teachers (schools) voluntarily participated in the study. Thus, inference beyond the 386 student respondents should be made with caution.

Instrumentation

An instrument developed by Wise (1993) was updated and used in this study. The instrument included Likert-type scales to measure student's perceived knowledge of 19 sustainable agriculture practices commonly advanced in Iowa and student's perceived impact of sustainable agriculture on 23 aspects of agriculture and the environment. Wise (1993) reported Cronbach alpha coefficients of .90 and .82 for the knowledge and impact measures, respectively.

Results

Student Knowledge of Sustainable Agriculture

A four-point scale (1 = know nothing, 2 = know a little, 3 = know some, 4 = know a lot) was used as a self-measure of student knowledge for 19 sustainable agriculture practices commonly advanced in Iowa. The findings revealed that students have additional things to learn about sustainable agriculture. The data in Table 1 show

Table 1. Student Knowledge of Sustainable Agriculture Practices (n = 386)

Knowledge Statement	M	SD	KN %*	NL %*	KS%*	KAL %*
No-till	2.84	1.04	15.9	15.1	37.6	31.3
Rotational grazing	2.76	.95	12.0	24.0	40.2	23.8
Livestock manure management	2.58	.99	17.8	25.7	37.4	19.1
Low input livestock facilities	2.40	.89	22.2	29.0	35.5	13.3
Hoop houses and deep bedding for swine	2.42	1.07	26.4	23.2	32.4	10.0
Buffer strips	2.36	1.07	29.2	21.7	32.9	16.2
Ridge tillage	2.35	.97	24.3	28.5	35.5	11.7
On-farm research	2.33	.93	21.5	34.6	33.1	10.8
Herbicide resistant crops	2.33	.99	24.9	29.6	33.0	12.6
Insect resistant crops	2.32	.93	21.7	35.2	32.1	11.0
Narrow strip intercropping	2.30	.99	26.7	28.3	33.5	11.5
Biological control of pests	2.27	.99	26.9	31.3	30.0	11.7
Integrated pest management	2.21	.92	26.4	34.7	30.8	8.1
Fall seeded cover crop	2.21	.99	30.7	27.3	32.0	10.0
Filter strips	2.20	1.01	31.1	27.9	29.8	11.0
Row banding of herbicides	2.17	.97	30.0	33.2	26.9	9.9
Late spring soil nitrate test	2.08	.94	33.4	31.3	28.7	6.5
Agroforestry	1.85	.94	46.3	28.8	18.6	6.3
Allelopathy	1.57	.89	65.8	15.7	14.4	4.2

*KN = know nothing; KL = know little; KS = know some; KAL = know a lot

that the mean scores for the practices were below midpoint (2.5) on the four-point scale for all but three of the practices: no-till, rotational grazing, and livestock manure management. These same three practices were also the only ones on which 50% of the students rated themselves as either "know some" or "know a lot." Over two-thirds of the students rated themselves as "know some" or "know a lot" about no-till, a practice were the soil is not tilled before planting, crops are planted in narrow rows, and herbicides are used to control weeds (Logan, 1990). The four animal related practices studied (rotational grazing, livestock manure management, low input livestock facilities, and hoop houses with deep bedding for swine) were among the top five in knowledge scores with means ranging from 2.42 to 2.76.

Wise (1993) also found that Iowa agricultural education students had a relatively high knowledge of rotational grazing. Livestock and manure management practices have been the focus of research and extension initiatives in Iowa in recent years (Leopold Center for Sustainable Agriculture, 1998, 1999). Students had the least knowledge of "allelopathy" and "agroforestry," with means below 2.0 on a four-point scale, and more than 75% of the ratings being "know nothing" or "know little."

Expected Impact from Sustainable Agriculture

The instrument included 23 items to measure expected impacts from sustainable agriculture. A five-point scale was used where 1 = very unlikely, 2 = somewhat unlikely, 3 = unsure, 4 = somewhat likely, and 5 = very likely. Table 2 reports the means, standard deviation, and percentages for each of the impact statements. Students perceived sustainable as having an impact on all three components of sustainable agriculture: economic, environmental, and social. The means for all 23 expected impacts were above midpoint (3.0) on a five-point scale. Nine of the impacts had means greater than 3.5. These included "conservation of soil," "changes in equipment," "protection of water quality," "greater management requirements," "more livestock," protection of wildlife," "safer food," "protection of woodlands," and "benefits for society." Also, over 50% of the respondents perceived these items as "somewhat likely" or "very likely" impacts from sustainable agriculture. Strongly embedded in these highest rated expected impacts are elements of environmental and social outcomes and, to a lesser degree, economic dimensions.

Conclusions and Recommendations

Respondents rated themselves as having limited knowledge of sustainable agriculture practices; however, the ratings of impacts expected from sustainable agriculture were high. Expected impacts were especially high for environmental and social dimensions, but less so for economic aspects. Similar thoughts regarding sustainable agriculture were observed among Iowa farmers (Duffy, 1999). These divergent findings between perceived knowledge and expected impact seem to parallel the agricultural industry with regard to sustainable agriculture. Sustainable agriculture may still be more of a philosophy, advocating economic, environmental, and social benefits, than a knowledge base featuring approved farming practices. The food and fiber system is in the beginning stages of responding not only to what humanity needs today but also to what future generations will require (Brady, 1990).

Student belief that sustainable agriculture has the potential to have a positive impact on agriculture provides a foundation for additional learning. On the basis of students' belief that sustainable agriculture has the potential to influence environmental, social, and economic dimensions of agriculture, curriculum specialists and teachers can develop teaching and learning opportunities where students can expand their knowledge of sustainable agriculture practices. As research yields new findings, educators should integrate appropriate technologies into the school curriculum, allowing students to develop the knowledge that will help them realize the potential they see in sustainable agriculture.

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Table 2. Student Expected Impact from Sustainable Agriculture (n = 386)

Expected Impact Statement	M	SD	VU%*	SU%*	U%*	SL%*	VL%*
Conservation of soil	3.69	.90	2.1	6.5	28.5	45.7	17.2
Changes in equipment	3.68	1.00	2.6	8.4	29.6	36.9	22.5
Protection of water quality	3.66	.96	3.4	6.5	28.7	43.1	18.3
Greater management requirements	3.58	1.00	3.4	8.4	33.4	36.0	18.8
More livestock	3.57	1.00	3.9	8.1	35.2	32.4	20.4
Protection of wildlife	3.56	1.03	4.2	9.9	30.0	37.9	18.0
Safer food	3.55	.99	4.2	7.3	33.9	38.3	16.3
Protection of woodlands	3.53	.98	4.2	9.9	30.0	37.9	18.0
Benefits for society	3.51	.91	3.1	7.3	36.6	40.8	12.0
Increased labor requirements	3.46	.93	3.4	7.3	42.7	33.2	13.4
Benefits for citizens of Iowa	3.42	.94	3.7	10.2	38.4	36.6	11.2
Reduced pollution	3.42	1.03	4.7	11.5	36.0	32.6	15.1
Improved livestock management	3.41	1.10	5.2	9.1	39.4	32.1	14.1
Reduced use of chemicals	3.41	1.04	4.7	12.8	34.7	32.6	15.1
Improve quality of life	3.39	.99	5.2	8.1	42.3	30.8	13.6
Better rural communities	3.34	.98	4.5	11.8	40.8	31.2	11.8
Younger farmers to begin farming	3.33	1.08	7.9	11.0	33.8	35.1	12.3
Reduced need for off-farm inputs	3.30	.96	5.5	9.4	45.2	30.0	9.9
More expensive food	3.28	1.03	6.0	13.8	37.3	31.9	11.1
Higher profits for farmers	3.27	1.07	7.8	10.4	42.6	25.6	13.6
Reduce use of petroleum energy	3.21	.96	5.8	10.7	50.0	23.6	9.9
Lower profits for farmers	3.13	.95	5.5	15.9	45.7	25.6	7.3
More small farms	3.02	1.10	10.2	20.1	35.5	25.6	8.6

*VU = very unlikely, SU = somewhat unlikely, U = unsure, SL = somewhat likely, VL = very likely

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