2000

Environmental Education Programming for the Louisiana Cooperative Extension Service.

John William Branch
Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation
https://digitalcommons.lsu.edu/gradschool_disstheses/7341

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

Bell & Howell Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

UMI
ENVIRONMENTAL EDUCATION PROGRAMMING FOR THE LOUISIANA COOPERATIVE EXTENSION SERVICE

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in

The School of Vocational Education

by

John William Branch
B.S., University of Tennessee, 1964
M.S., University of Tennessee, 1969
M.B.A., California State College at Bakersfield, 1978
December 2000
ACKNOWLEDGMENTS

The members of my graduate committee, Dr. Pesson, Dr. Gassie, Dr. Burnett, Dr. Kuetemeyer, and Dr. Mitchell, have given much of their time and patience, and have provided excellent guidance, advice and support. My major professor, Dr. Verma, has worked hard for many years to guide me through this effort. His patience and continuous support and encouragement will always be remembered and appreciated.

The faculty, staff and administration of the Louisiana Cooperative Extension Service have been very supportive. Extension faculty in many states have set good examples of the significant roles extension can play in environmental education. The energy, enthusiasm and expertise of 4-H Agents, Home Economists, County Agents and Specialists working to help people learn how to take care of their environment insures that extension will play an increasingly important role in environmental education.

Environmental education has talented and dedicated K-12th grade teachers, strongly supported by university faculty and state and federal agency staff. Non-profit organizations, businesses, and industries provide support for environmental education. Volunteers give their time, energy and expertise to make Louisiana a better place to live. These people deserve the appreciation and support of every citizen.

A special thanks goes to Mrs. Patricia Creel for her generous and skillful help in completing this paper, and to Cindy Couvillion, Bonnie Mann, and Linda Forester for answering so many questions about spread sheets and word processing.

My wife and best friend, Patricia Craig Branch, deserves credit for whatever value this work may contribute to extension educators and to environmental education.

I appreciate all your help, your encouragement and your patience.
TABLE OF CONTENTS

Acknowledgments .............................................................................................................. ii

List Of Tables ..................................................................................................................... v

List Of Figures ....................................................................................................................... vi

Abstract ............................................................................................................................... viii

Introduction ......................................................................................................................... 1
  Louisiana Cooperative Extension Service Environmental Education Program . 2
  Environmental Issues Affecting Louisiana Agriculture ....................................... 6
  Problem Statement .................................................................................................. 6
  Purpose And Objectives ......................................................................................... 7
  Significance Of The Study ..................................................................................... 7

Review Of Literature .......................................................................................................... 9
  Origins Of Environmental Education In The United States ............................ 10
  State Environmental Education Legislation .................................................... 13
  National Environmental Education Resources ................................................. 16
  Louisiana Post Secondary Environmental Education Programs .................. 21
  Louisiana State Government Environmental Education Programs .............. 23
  Non-Governmental Organizations ...................................................................... 24
  Surveys Of Youth And Adult Audiences ............................................................ 25
  Comparative Risk Surveys ................................................................................... 37
  Survey Of Environmental Education And Literacy In Louisiana ................... 40
  Extension Service State Issues Surveys .............................................................. 41
  Agricultural Water Quality Issues ...................................................................... 45
  Sustainable Development ..................................................................................... 48
  Sustainable Agriculture ....................................................................................... 56
  Organizing And Working With Advisory Groups ............................................. 58
  The Delphi Method ............................................................................................. 61
  Expansion Of The LCES Environmental Education Program ..................... 62
  Programming Models ........................................................................................... 68
  Process Skills Needed By Environmental Education Faculty ........................ 72
  Strategic Skills Needed By Environmental Education Faculty ........................ 77

Summary of Review of Literature by Objective ............................................................ 93
  Objective 1 ............................................................................................................ 93
  Objective 2 ............................................................................................................ 99
  Objective 3 .......................................................................................................... 102
  Objective 4 .......................................................................................................... 105

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
LIST OF TABLES

1. Number of Delphi round 1 instrument topics listed in each environmental category ........................................ 111
2. Number of respondents and non-respondents who were estimated to be in senior-career, mid-career, or early-career status in their agencies .... 114
3. Number of Delphi panelists reporting years of experience by agency .... 115
4. Number of Delphi round 1 topics rated by number of panelists ............... 119
5. Number of panelists rating number of Delphi round 1 topics ................. 119
6. Number of topics added by panelists in Delphi round 1 by environmental category .............................................. 120
7. Number of topics added by panelists in response to Delphi round 1 ......... 120
8. Number of Delphi round 2 topics rated by number of panelists ............... 121
9. Number of panelists rating number of Delphi round 2 topics ................. 122
10. Number of Delphi round 1 rating changes made by number of panelists in Delphi round 2 ........................................ 123
11. Effect on movement of Delphi round 2 mean from changes by panelists in Delphi round 1 rating .................................................. 124
12. Number of cases where rating was changed one, two, three, or four places on the rating scale and potential effect on location of round 2 mean .... 125
13. Number of cases where the difference in means of topic ratings in Delphi rounds 1 and 2 was zero, less than 0.025, or equal to 0.025 .......... 126
14. Means of 55 Delphi round 1 environmental topic ratings ..................... 128
15. Means of 80 Delphi round 2 environmental topic ratings ..................... 134
16. Average of Delphi round 2 topic ratings by farm commodity categories . 140
17. Average of Delphi round 2 topic ratings by environmental categories .... 141
1. Number of respondents and non-respondents by career status .......... 114
2. Range of years of experience reported by Delphi panelists by agency ... 116
3. Ranked distribution of means of 55 Delphi round 1 topic ratings .......... 130
4. Average of Delphi round 1 topic ratings by environmental category ..... 131
5. Frequency of selection by panelists of each rating in Delphi round 1 ... 131
6. Ranked distribution of means of 80 Delphi round 2 topic ratings .......... 137
7. Frequency of selection by panelists of each rating in Delphi round 2 ... 138
8. Frequency of selection by panelists of each rating for the private water well protection topic in Delphi round 2 ................................. 138
9. Frequency of selection by panelists of each rating for the application of forest waste to agricultural land topic in Delphi round 2 ..................... 139
10. Frequency of selection by panelists of each rating for the coastal erosion topic in Delphi round 2 ......................................................... 139
11. Frequency of selection by panelists of each rating for the land leveling education topic in Delphi round 2 ........................................... 140
12. Average of Delphi round 2 topic ratings by environmental category ... 142
13. Means of Delphi round 2 topic ratings for the drinking water category .... 142
14. Means of Delphi round 2 topic ratings for the nonpoint source category ... 143
15. Means of Delphi round 2 topic ratings for the point source category .... 144
16. Means of Delphi round 2 topic ratings for the ground water category ... 144
17. Means of Delphi round 2 topic ratings for the air quality category ..... 145
18. Means of Delphi round 2 topic ratings for the solid waste category ....... 145
19. Means of Delphi round 2 topic ratings for the multi-media category ... 146
20. Comparison of agricultural agency staff and non-agricultural agency staff averages of Delphi round 2 topic ratings by environmental category .......................................................... 147

21. Comparison of senior-career and junior-career staff averages of Delphi round 2 topic ratings by environmental category .......................................................... 147

22. Comparison of environmental category averages in Delphi rounds 1 and 2 excluding 25 added topics ................................................................................ 149

23. Averages for nonpoint source, solid waste, and multi-media categories in Delphi rounds 1 and 2 (excluding added topics) and 25 added topics .............................. 149

24. Means of 55 Delphi rounds 1 and 2 environmental topic ratings .......................... 150
ABSTRACT

Environmental education is a component of community-based education programs. Environmental education in the United States and in Louisiana was described. (Objectives 1 and 2)

Because of rapid changes in environmental science, and the responses of citizens to environmental topics, extension faculty need additional programming techniques and more process and strategic skills training. Programming techniques and skills training were reviewed. (Objective 3)

Extension has included representatives from key state and federal agencies with expertise in, and responsibility for, environmental topics on its environmental education advisory committees. The Delphi technique was utilized in this study, with agency representatives as panelists, to determine and prioritize subject matter content for an environmental education program to be delivered to farmers. (Objective 4)

The Round 1 instrument included a list of 55 environmental topics which was provided to 56 state and federal agency representatives. Panelists were asked to rate the topics for inclusion in an environmental education program for farmers and were invited to add topics. Of 56 potential panelists, 41 responded, and ten added 25 topics.

The Round 2 instrument included the individual panelist’s Round 1 ratings, the mean of the panel’s Round 1 ratings, the 25 added topics, a request to rate the added topics, and an invitation to change any Round 1 rating. Of 41 Round 1 panelists, 40 responded to Round 2. Most chose not to change any of their Round 1 topic ratings.

Drinking water and point source water quality categories of topics received higher ratings while air quality and solid waste categories received lower ratings.

viii
The Delphi method provided an efficient and inexpensive technique for obtaining the views of agency experts. It is one method for obtaining input from advisory committees, for enhancing collaboration between extension educators and agency representatives, and for helping panelists learn more about a wide range of environmental topics. It should be used by extension environmental educators.
INTRODUCTION

The Louisiana Cooperative Extension Service is responsible for off-campus, non-formal education. It is part of the Louisiana State University Agricultural Center (LSU AgCenter), which also includes the Louisiana Agricultural Experiment Station and the Office of International Programs. The LSU AgCenter is one of the campuses of the Louisiana State University System.

Part of the Louisiana State University (LSU) heritage includes the Morrill Act passed by Congress in 1862 which provided for the teaching of the agricultural and mechanical arts. The Hatch Act passed by Congress in 1887 provided for agricultural research. The Smith-Lever Act passed by Congress in 1914 provided for the extension of research-based information and education to those who were not currently enrolled in college. (U. S. Department of Agriculture, 1962)

The agricultural portion of the teaching function prescribed by the Morrill Act is performed by the College of Agriculture of the Louisiana State University in Baton Rouge. The agricultural research function prescribed by the Hatch Act and the extension function prescribed by the Smith-Lever Act are performed by the Louisiana Agricultural Experiment Station and by the Louisiana Cooperative Extension Service, respectively.

The Louisiana Cooperative Extension Service has an office in each parish and works with many audiences. Most of its faculty have degrees in disciplines such as agriculture, forestry, fisheries, engineering, economics, home economics, or education and reside in the parishes where they work. Traditional audiences include farmers, foresters, and fishermen for the agriculture and natural resource faculty (county agents), householders for the home economics faculty (home economists), and youth for the 4-H
Additional audiences for all faculty include volunteers, community leaders, public employees, elected officials, agricultural suppliers and processors, and representatives of other small businesses and industries. Extension specialists with state responsibilities provide on-site, electronic or print communications support to agents with parish and multi-parish responsibilities.

The Louisiana Cooperative Extension Service education programming in agriculture and natural resources is conducted by commodity and subject matter. Agronomy specialists develop education programs to address the needs of county agents supporting farmers who produce soybeans, sugar cane, cotton, corn, rice, pasture, hay and forage. Animal science specialists develop education programs to address the needs of county agents supporting farmers who produce dairy products, beef cattle, swine or broilers. Forestry, wildlife and fisheries specialists develop education programs to address the needs of county agents supporting foresters, wildlife managers and fishermen. Home economics specialists develop education programs to address the needs of home economics agents supporting householders in food and nutrition, clothing, housing, financial planning and family well being. 4-H specialists develop education programs to support the work of 4-H agents with youth, teachers and volunteers. Engineering, entomology, economics, sociology and communications specialists develop education programs to address specific needs of audiences served by other subject matter specialists and agents.

**Louisiana Cooperative Extension Service Environmental Education Program**

As part of traditional extension education programs, agents have responded to requests for information regarding environmental topics such as private water well
protection, drinking and irrigation water quality, waste and waste water management, indoor air quality, and energy conservation. Specific education programs targeting problem areas such as animal waste management, point-of-use drinking water treatment, individual household sewage system operation and maintenance, and housing design, construction, operation and maintenance, have been developed and implemented by engineering and home economics specialists. Cooperation with representatives of local, state and federal agencies, other colleges and universities, professional associations, volunteers, and private sector organizations in delivering environmental education programs has been common practice.

The U. S. Environmental Protection Agency and its state agency counterparts focused their early efforts on the most serious environmental problems and much progress was made. Environmental research and education played a significant role in the development and implementation of technologies to reduce pollution. Public awareness and interest in a wide range of environmental topics has increased and concerns have been expressed about the environmental impacts of practices used by agricultural, forestry and fisheries producers and processors, rural householders, small businesses and industries, and both large and small municipalities. Traditional audiences, such as farmers, small business operators and local government officials, have found themselves targeted as contributors to environmental problems. Farmers, whose families live on the land they farm, found this to be an unusual and uncomfortable position.

The Louisiana Cooperative Extension Service responded to a variety of these concerns by redirecting some of its existing resources and by acquiring new resources.
through grants and contracts. Energy conservation contract funds from the U. S.
Department of Energy and the Louisiana Department of Natural Resources have
supported education programs targeting energy conservation in: homes; small
businesses; greenhouses; fruit, vegetable and seafood processing facilities; shrimp
fishing boats; irrigation water pumping; school physical plants, and solid waste and
waste water recycling. Five faculty supported by grant and contract funds were
combined with an existing faculty member into an Environmental Education Project.

Other environmental education programs have been supported by contracts with:
the U. S. Department of Agriculture Extension Service, the U. S. Department of
Agriculture Cooperative State Research, Education and Extension Service, the U. S.
Department of Agriculture Natural Resources Conservation Service, the Tensas
Resource Conservation and Development Council, the U. S. Environmental Protection
Agency, the U. S. Environmental Protection Agency Region 6, the Barataria/Terrebonne
National Estuary Program, the U. S. Fish and Wildlife Service, the Louisiana
Department of Environmental Quality, the Louisiana Department of Agriculture and
Forestry, the Louisiana Department of Wildlife and Fisheries, the Louisiana Department
of Health and Hospitals, the Louisiana Department of Natural Resources, the Louisiana
Farm Bureau Federation, and the Lake Pontchartrain Basin Foundation.

The U. S. Department of Agriculture Extension Service established water quality
as one of eight national priority initiatives in 1988 and provided funding to states for
water quality education beginning in 1989. A national base program called natural
resources and environmental management and an optional program called
environmental education began in 1991. (Verma and Bennett, 1993)
The Louisiana Cooperative Extension Service incorporated an education base program called Environment into its regular programming cycle in 1993. This base program included work done by Environmental Education Project faculty and other specialists and agents in the areas of water quality, waste management, energy conservation, pesticide management, and forestry and wildlife management. Annual reporting by faculty has included 10-19 Full-Time Equivalents per year. (LSU AgCenter, 1998)

In 1987, the U. S. Environmental Protection Agency estimated that public spending to maintain then-current levels of environmental quality would increase 2%-3% per year, but that the federal share was expected to decrease from 13% to 8% of the total, while local government's share was expected to increase from 76% to 87% of the total. Annual household expenditures for environmental services were expected to increase by 54% to 1.8% of household income. Household environmental expenditures in smaller cities (less than 500 population) were expected to increase to 5.6% of household income. (U. S. Environmental Protection Agency, 1990d)

In 1989, Lee Thomas, then Administrator of the U. S. Environmental Protection Agency, initiated an internal study of comparative risks associated with environmental threats. Results indicated risks from environmental threats were not highly correlated with the allocation of environment funds to address those threats. (U. S. Environmental Protection Agency, 1987 a,b,c,d,e) The discrepancy between actual risk and citizens’ perceptions of risks as indicated by their actions, the actions of legislators, and as indicated by the U. S. Environmental Protection Agency’s comparative risk studies suggested the need for increased levels of, and more effective, environmental education.
Environmental Issues Affecting Louisiana Agriculture

Farmers were extension’s first audience at a time when a large percentage of the population of the United States was involved in production agriculture. Louisiana’s farms are typically small, have little income, and are managed by older farmers who have little experience with, or awareness of, environmental issues. The 1997 Census of Agriculture defined a farm as any place from which $1,000 or more of agricultural products was produced and sold. It reported 23,823 farms in Louisiana, and while 47.3% of respondents considered themselves full-time farmers, only 40% reported sales of more than $10,000 per year. The average age of all farmers was 53.7. (U. S. Department of Agriculture, 1999)

The President’s Clean Water Action Plan posed over 100 action items to be taken if surface waters were to meet existing water quality standards. Some of these action items could have significant impacts on farms as well as on small businesses and communities. (Browner and Glickman, 1998)

Problem Statement

High levels of public and private expenditures on environmental services, and high levels of concern about environmental issues, require taxpayers and consumers to become more environmentally literate and concerned. They need to be knowledgeable, concerned and skilled enough to influence members of congress, state legislators, local government, business and industry, and their neighbors in pursuing risk-efficient allocation of resources toward achieving an acceptable level of quality of life for present and future generations. Farmers need to be informed about environmental regulations, about practices that can be used to comply with the regulations, and about the expected

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
economic, environmental and social impacts on farming operations and rural communities. Farmers need enhanced leadership and interpersonal skills if they are to sustain themselves and their communities in a global economy.

Purpose and Objectives

The purpose of this study was to determine appropriate subject matter content for an environmental education program to be delivered by the Louisiana Cooperative Extension Service to Louisiana farmers. Specific objectives were to:

1. Describe environmental education in the United States.
2. Describe environmental education in Louisiana.
3. Describe components of existing extension education programming models which would improve the effectiveness of environmental education programming by the Louisiana Cooperative Extension Service.
4. Determine subject matter content perceived by agricultural and natural resource agency professionals as appropriate for delivery in an environmental education program for farmers in Louisiana.

Significance of the Study

Environmental issues are affecting decisions made by farmers and other land owners in Louisiana. The impact of changes in environmental policies and regulations may increase production costs and limit options available to farmers for cultural practices employed on farm land. Farmers need to be informed about these issues and they need enhanced leadership, interpersonal, and planning skills to help improve their efforts toward sustainability and their perception by the general public, agency representatives, elected officials and legislators. This study should provide an indication...
of appropriate subject matter and skills training needed for an environmental education program directed to farmers by the Louisiana Cooperative Extension Service faculty.

An effective environmental education program for farmers can provide a model for environmental education programming directed to other audiences. Such a program could improve the environmental and scientific literacy of all audiences. It could increase citizens' concern for the environment and their willingness and capability to take appropriate action to effect positive changes. The result could be a more sustainable society.
REVIEW OF LITERATURE

The literature pertinent to environmental education in the United States and in Louisiana (Objectives 1 and 2) is extensive. This review is intended to be representative enough to reflect the organizations providing environmental education resources in the United States and in Louisiana, the subject matter and skills they utilize, and their audiences. Samples of legislation enacted by some states and by the United States Congress providing for formal environmental education for K-12th grade students and nonformal environmental education for some audiences will be reviewed. Representative actions of local, state and federal agencies, business and industry, universities, professional associations and non-governmental organizations in conducting training and/or providing resources in support of environmental education for their staff, members and other audiences will be reviewed.

Experiences of extension services in other states, as well as of the Louisiana Cooperative Extension Service, the U. S. Department of Agriculture, the Louisiana Department of Agriculture and Forestry, and other organizations in providing environmental education programs for farmers will be key components of the review for determining subject matter needs. Needs for environmental education will be indicated by national and state surveys of citizen attitudes and behaviors, the comparative risk evaluations conducted by the U. S. Environmental Protection Agency, the U. S. Environmental Protection Agency Region 6, and the Louisiana Department of Environmental Quality, research in environmental education, and global, national and local environmental trends. Education for sustainability will be reviewed as an appropriate extension environmental education program component. Skills needed by
extension audiences will be reviewed. Trends in natural resource management, agricultural development, communications, and population will be reviewed as a means of predicting future subject matter needs for environmental education.

Existing extension education programming models used by the Louisiana Cooperative Extension Service and other cooperative extension services will be reviewed for components of a programming model which should be appropriate to extension environmental education needs. (Objective 3).

Objectives 1, 2, and 3 will provide indications of subject matter content needed for an environmental education program to be directed to farmers. Research will be conducted to obtain specific subject matter content and priorities. (Objective 4).

Origins of Environmental Education in the United States

Braus and Disinger (1998) reported that Nature Study for the Common Schools by Wilbur Jackman in 1891 was one of the early documents supporting studies of the environment. They reported that conservation of natural resources was discussed by the Educational Policies Commission of the National Education Association in 1935 and that outdoor education was promoted by L. B. Sharp in the mid-1900s. They reported that John Dewey's progressive education movement focusing on learning by doing and that the emergence of ecology as a science encouraged a holistic approach to the study of the environment.

Braus and Disinger (1998) reported that the United Nations Conference on the Human Environment in Stockholm, Sweden, recommended the establishment of international programs of environmental education. They reported that both the Belgrade Charter in 1975, and the Tbilisi Conference in 1977, advocated
interdisciplinary approaches to environmental education. They reported that the Brundtland Commission in 1987, and the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, reinforced the need to consider social equity, economics, culture and political structure in environmental education. Braus and Disinger reported that the National Environmental Policy Act of 1969 and the National Environmental Education Act in 1970 provided minimal support for K-12th grade environmental education programs. They reported that the 1990 National Environmental Education Act provided broader support for environmental education.

Schoenfeld (1984) traced the beginning of much of the environmental movement in the United States to hunters and fishermen. He was a journalist and the founding editor of the Journal of Environmental Education in 1969.

Tanner (1984) determined the most-cited authors in the Journal of Environmental Education and in Current Issues in Environmental Education for the years 1976-1983. He compared his list with the one developed by Force from the 1969-1974 issues of the Journal of Environmental Education. He concluded that the earlier works were dominated by discussion of the environmental foundations of environmental education while the later works were more involved with psychological foundations, pedagogy, and the affective domain. He interpreted this as an indication of maturation of the field.

The National Environmental Education Act created the Environmental Education and Training Program which funded a consortium headed by the University of Michigan in 1992. The National Consortium for Environmental Education and Training (NCEET) developed a database of environmental education programs which
could be accessed using the internet. NCEET conducted a survey of state environmental education coordinators to determine the status of in-service training and directions for improvement. The survey found that state coordination of in-service training was largely informal and that training was not a high priority. Natural resource agencies were the most prominent providers of training with Project Learning Tree and Project Wild being the most widely used training programs. Respondents felt that trainers were knowledgeable about environmental content but lacked background in pedagogy. Science and elementary teachers were more likely than non-science and secondary teachers to seek training. Respondents said rural teachers were not well-reached by training efforts. NCEET staffers felt that urban, inner-city teachers were not well-reached. (National Consortium for Environmental Education and Training, 1994)

The National Environmental Education Act of 1990 also established an Environmental Education Grants Program. Regional U. S. Environmental Protection Agency offices could award grants up to $25,000 and the U. S. Environmental Protection Agency could award grants of more than $25,000. In FY 92, $2.47 million was awarded in 219 grants. About 75% of the FY 92 grants were for $5,000 or less. Three were awarded to recipients in Louisiana. The Nature Conservancy received $5,000, the University of Southwest Louisiana received $25,000, and Southern University received a $170,000 grant, which was one of the two largest grants awarded. (U. S. Environmental Protection Agency, 1992)

In FY 93, $2.7 million was awarded in 264 grants. Nearly 90% went to grants of $5,000 or less. Three were awarded to recipients in Louisiana. The City of Shreveport received a $5,000 grant. The LSU AgCenter received a grant for $5,000 to support an
environmental camp and a grant for $85,000 to support a low-literacy recycling program. (U. S. Environmental Protection Agency, 1993)

The Environmental Education and Training Partnership (EETAP) was funded by the U. S. Environmental Protection Agency in 1995 to provide training for teachers and other education professionals, enhance existing clearinghouses, and facilitate partnerships of education and environmental professionals. EETAP was formed by a consortium headed by the North American Association for Environmental Education (NAAEE) and builds on the work done by NCEET. (Duckworth, 1998)

Kirk, Wilke and Ruskey (1997) surveyed state representatives to find out how many of 16 components of a comprehensive environmental education program were in effect. All fifty states responded and while no state had all 16 components, twelve reported having 8 to 12 components in place and were making progress toward attaining other components. The authors recommended repeating the survey every other year to keep track of progress.

**State Environmental Education Legislation**

Several states passed legislation to support environmental education. Formal education in the K-12th grades was the focus but nonformal programs were included by some states. The New Jersey Legislature passed the Environmental Education Act of 1971. It provided funds for staff of an Environmental Education Council. An Executive Order created the New Jersey Environmental Education Commission in 1989 which identified goals and made recommendations to the Governor in 1990. The Commission was reconvened in 1991 to develop a plan of action which was completed in 1992. (New Jersey Environmental Education Commission, 1993)
Kentucky revised its Conservation Statute to become the Environmental Education Act in 1972. The Kentucky Association of Environmental Educators developed an Environmental Literacy Project which produced a report calling for an environmentally literate Kentucky in 1989. (Kentucky Association for Environmental Education, 1989)

The Florida Environmental Education Act (1989) designated public schools, community colleges and state universities as the primary delivery systems for environmental education. The Act provided for an Office of Environmental Education, an Executive Director and staff, and an Interagency Coordinating Committee for Environmental Education. The Act established grants for environmental education programs targeting visitors and tourists, and Florida residents who seldom received services from the state's system of public education.

The Minnesota Environmental Education Act (1990) targeted pupils and other citizens, and provided for a Director, a Board, and an Advisory Committee to receive input on K-12th grade, post-secondary, and informal environmental education programs. It provided for Regional Environmental Education Resource Centers to serve as a source of information and programs, and to provide contact for public feedback.

The Ohio Environmental Education Fund (1993) authorized $1.5 million each year to support environmental education programs. It received half of the civil penalties collected by the Ohio EPA's air and water pollution control programs. It provided for a Board of Trustees to receive recommendations on grant funding from peer review panels of citizen volunteers.
The Pennsylvania Environmental Education Act (1993) created the Advisory Council on Environmental Education to advise the Secretary of the Department of Education and the Secretary of the Department of Environmental Resources. It established an Environmental Education Fund with 5% of the fines and penalties collected by the Department of Environmental Resources.

The Louisiana Environmental Education Act (1993) established a Louisiana Environmental Education Commission to conduct a study of a plan for environmental education and the policies and practices needed. The Commission was to provide a forum for the discussion and study of environmental problems, to obtain information needed to coordinate the environmental education programs of state agencies, and to administer an environmental education grants program. The Louisiana Legislature reenacted the Louisiana Environmental Education Act (1995). It added a coordinator in the Office of the Governor, created the Office of Environmental Education, and added representatives of the Louisiana Environmental Education Association as members of the Louisiana Environmental Education Commission.

The Council of State Governments (1993) issued a sample environmental education act patterned after legislation enacted by several states. It described a board to guide the state environmental education program, an office to administer it, and an interagency coordinating committee to facilitate cooperation among state agencies. It called for a state plan, a grants program, and regional environmental education centers.

The U. S. Congress and the legislatures of many states have established frameworks for supporting environmental education in formal classroom settings and, in some cases, in nonformal education.
National Environmental Education Resources

There are many resources for environmental educators including universities, state and federal agencies, local government, non-governmental organizations, and business and industry. Several extension services have conducted environmental education programs. Wilkins and McNeil (1971) conducted pre- and post-tests of knowledge gained by land owners in three New York Cooperative Extension wildlife management education programs. They found high levels of knowledge about the subject on pre-tests. The least gain in knowledge as indicated by the post-test scores was by the group with the highest pre-test scores. They were able to make recommendations to extension faculty for improving the effectiveness of future environmental education programs. Andrews and Jordahl (1987) reported on extension natural resource and environmental education programs in Wisconsin which covered a wide range of issues and used many different delivery techniques.

The University of Wisconsin Extension Service produced Farm*A*Syst, a private water well protection education program in 1989. It has been adapted for use in all fifty states, several territories and the Province of Ontario. One of the adaptations was called Home*A*Syst which was applicable to householders who were interested in investigating their home’s environmental status. Farm*A*Syst was particularly important to farmers as many depended on water wells for their family drinking water, for their livestock watering, and for irrigation. Contamination of a private water well posed a serious liability threat to the well owner. (Farm*A*Syst/ Home*A*Syst National Program, 1997). Moreau (1996) conducted a cost-benefit analysis of the adoption of water well protection measures by Louisiana farmers. He found that 134...
farmers decided to spend an average of $682 to improve the protection of their water wells after their introduction to the Farm*A*Syst program. Andrews directed an extension team which reviewed the available curriculum for teaching youth about water. Wisconsin extension faculty developed the Give Water a Hand education program which has been used by students, teachers and volunteers to better understand water systems in their communities. (University of Wisconsin, 1996).

The University of Florida Extension faculty produced Earth Connections and Soil, Water and Land Use for 5-11 year old and 13-18 year old audiences. (U. S. Department of Agriculture, 1996a)

N. J. Smith-Sebasto (personal communication, August 1996) hosted the extension Environmental Education Summit for over 60 extension faculty from 31 states and territories. In response to a pre-summit survey, extension faculty reported their most pressing state environmental issues were water quality and management, nonpoint source, and ground water. Land use practices and development policies, and urban sprawl were mentioned frequently. When asked which issues or questions they would like to see addressed at the summit, faculty responded that more coordination and sharing of environmental education methods and materials, sources of funding, water issues, and building a youth environmental ethic with youth were important.

Smith-Sebasto (1998) surveyed 188 Illinois extension faculty regarding their preparation to infuse environmental education concepts into their programming and their attitudes toward environmental education. He found that environmental education did not play a major role in extension education programming and that faculty were not confident of their ability to conduct environmental education programs. Twenty-one
faculty indicated having received post-secondary education. Forty-three had received continuing education or had taken one or more graduate courses in environmental education concepts. Seventy-eight said they were delivering environmental education programs. Those who were not said they did not have enough knowledge or background, that other concepts were more important, or that they did not have enough resources or funding. Those who were delivering environmental education programs felt that it was important to include environmental education concepts in their programming, that one of their goals was to increase their audience’s level of environmental responsibility, and that they were effective in infusing environmental education concepts into their programming.

Bakshani and Allen (1992) contacted over 140 people from 80 universities and colleges in regards to their pollution prevention education programs during the period December, 1991 through February, 1992. Information was received from 80 people associated with 50 institutions. Most (66%) were from science and engineering disciplines, but 14% were from social sciences and liberal arts, and 9% were from business and management disciplines. The authors reported that over 30 business schools had elective environmental courses, and that 70 schools had incorporated environmental management into their core curriculum.

The U. S. Agency for International Development supported a survey of 92 North American universities with undergraduate and graduate programs in natural resource and environmental management. Information about curricula, degrees offered, enrollment, setting, and international programs was supplied by 72 universities. (Kelly, 1995)
The U. S. Fish and Wildlife Service established a National Conservation Training Center in Shepherdstown, West Virginia. It hosted over 5,000 professionals from more than 80 organizations and a dozen countries during its first six months of operation. (U. S. Department of the Interior, 1998) The U. S. Geological Survey (USGS) is a federal research agency focusing on water and geology. It produced reports and maps which have been useful to environmental educators. (U. S. Department of the Interior, 1987, 1996, 1999) In cooperation with the Louisiana Department of Transportation and Development, the USGS produced a Louisiana ground water publication which has been widely distributed to teachers. (Stuart, Knochenmas, McGee, 1994) The National Aeronautics and Space Administration (1997) produced lesson plans and charts for use by teachers. The U. S. Department of Agriculture Soil Conservation Service produced environmental education lesson plans concerning soil, water, plants, climate and wildlife. (U. S. Department of Agriculture, 1981) They produced a document describing the status of private lands in the United States and the measures being taken to conserve them. (U. S. Department of Agriculture, 1996b) The Office of the Secretary provided a clearinghouse for lesson plans to be used in introducing students to agricultural sciences. (U. S. Department of Agriculture, 1996c)

sustainability which have been widely distributed. (Wasserman, 1998) The Enterprise for Education published Clean Air Challenge to help bring air quality issues into the classroom. (Lord, 1998)

The North American Association for Environmental Education (1998) conducts annual conferences attended by K-12th grade teachers, university faculty, nonformal educators and business people. It produces publications for use in environmental education. It was organized in 1971 and had over 2,000 members from over 50 countries in 1998.

Louisiana Post Secondary Environmental Education Programs

Many colleges and universities offered undergraduate and graduate degrees in environmental sciences. LSU provided a bachelor of science degree in environmental management systems through the College of Agriculture. A master of science degree in environmental sciences with options in environmental toxicology, or environmental planning and management, was available through the Institute for Environmental Studies. The College of Engineering offered a bachelor of science degree in environmental engineering, as well as a doctor of philosophy degree in civil and environmental engineering. (Louisiana State University, 1999)

Environmental research has been conducted by LSU. The College of Engineering houses four environmental research programs: the Hazardous Substance Research Center; the Hazardous Waste Research Center; the Institute for Recyclable Materials; and the Water Resources Research Institute. The Institute for Environmental Studies’ research activities included environmental assessment, regulations and management, genetic toxicology, acid deposition, hazardous waste management; and the environmental impact of energy systems. The Wetland Biogeochemistry Institute investigated sediment chemistry/plant relations and the chemical and biological behavior of plant nutrients and toxic substances in wetland ecosystems. The Coastal Ecology Institute specialized in computer modeling, plant and animal ecology, hydrology, wetlands restoration, and oceanography. (Louisiana State University, 1999)

The LSU AgCenter conducted research in 18 subject matter departments on the Baton Rouge campus and at 17 experiment stations located in the state. Research included variability of soil properties and their effects on water quality and soil
management, soil erosion and groundwater impacts, the effect of forest management practices on streams in Louisiana, mobility and retention characteristics of agricultural chemicals in clay soils, restoration of altered lands, pasture management in commercial loblolly pine plantations, and effects of water table management on surface and groundwater quality in shallow water table soils. (LSU AgCenter, 1993)

Faculty at the University of New Orleans (UNO) conducted research in urban waste management. UNO operated the Louisiana Technical Assistance Program with the Louisiana Department of Environmental Quality to provide pollution prevention assistance to small businesses. The UNO College of Education faculty developed educational materials related to wetlands and coastal issues. (University of New Orleans, 1994)

Southern University's Institute for Environmental Issues and Policy Assessment conducted studies of environmental issues. The reports, River Sentinel 1994, River Sentinel 1995, and Living Downwind: Community Environmental Exposure discussed the exposure of residents living along the Mississippi River industrial corridor to air pollution. (Southern University, 1994, 1995 and 1998)

The University of Louisiana at Lafayette conducted environmental programs through its Louisiana Environmental Training Center. (University of Louisiana at Lafayette, 1996)

Tulane University offered graduate courses in solid and hazardous waste management through their Civil Engineering Department. The Departments of Parasitology and Environmental Health Sciences have done extensive research on pathogen inactivation in sewage sludge. (Reimers and Voss, 1987)
Louisiana State Government Environmental Education Programs

The Louisiana Department of Agriculture and Forestry (LDAF) Office of Forestry conducted Project Learning Tree workshops for over 10,000 K-12 teachers and nonformal educators in over 500 workshops during the period 1987-1995. (Louisiana Department of Agriculture and Forestry, 1996) The LDAF Office of Soil and Water Conservation sponsored Project WET (Water Education for Teachers) as well as other training developed by their national counterpart, the National Association of Conservation Districts. (Duckworth, 1998)

The Louisiana Department of Culture, Recreation and Tourism (1983) conducted nature walks and bird watches, natural dyes demonstrations, and lectures on natural areas in, or near, state park facilities. They produced birding guides, nature trail maps, and nature interpretative brochures.

The Louisiana Department of Environmental Quality (1996) (LDEQ) worked with state and federal agencies and non-governmental organizations to conduct education programs on litter prevention and recycling, storm drain stenciling, stream monitoring, household septic system management, private water well protection, animal waste management, and urban runoff. It worked with landowners, foresters, loggers and industry representatives on the use of forestry best management practices for harvesting timber and managing logging roads. The LDEQ worked with local governments on implementation of urban storm water runoff controls. They implemented a citizen’s monitoring program on the Bogue Falaya and the Tangipahoa Rivers with the Citizens for a Clean Tangipahoa. A lawn care education program was initiated in Lafayette and continued in Monroe, Baton Rouge and Metairie.

23

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
The Louisiana Department of Health and Hospitals (2000) Office of Public Health provided education materials on the potential health effects of exposure to hazardous substances, and training to public water system operators/managers. The Office of Sanitarian Services produced a video, Dilution is Not the Solution, a related poster, and several public service announcements to encourage people to use appropriate individual household septage treatment systems. These videos and posters were widely distributed to science teachers.

The Louisiana Department of Natural Resources (2000) provided environmental education on coastal restoration and management issues, and on energy conservation.

The Louisiana Department of Wildlife and Fisheries (2000) conducted Project WILD, Project Aquatic Wild, hunter/fisherman education programs, and threatened and endangered species education programs.

Non-Governmental Organizations

The Louisiana Forestry Association (1988, 2000) provided leadership in use of best management practices to reduce soil erosion from logging operations. They worked closely with regulatory agencies and the industry to provide training to loggers, forest land owners and timber processors.

The Louisiana Farm Bureau Federation sponsored a private water well testing program with 997 water samples from 23 parishes tested by Heidelberg College as part of a national program conducted in 15 states. (Wallrabenstein and Baker, 1992). It led a state-wide review of best management practices. (LSU AgCenter, 1996) The League of Women Voters Education Fund (1994) produced an education program on groundwater, and another one on drinking water. (Mueller, 1997)
The Lake Pontchartrain Basin Foundation received funding from the U. S.
Environmental Protection Agency Region 6 for the development of Lessons on the
Lake: An Educator’s Guide to the Pontchartrain Basin. The guide was provided to
educators throughout the Lake Pontchartrain Basin along with training in its use as part
of a series of workshops. (Banbury and Rheams, 1997)

The Audubon Institute, with funding from the McKnight Foundation, conducted
the Riverside Coalition for Environmental Education which focused on environmental
concerns of people living along the Mississippi River. It developed an educational
program to address those concerns. (Thomas, Thomas and Maygarden, 1995)

Members of the Louisiana Environmental Educators Association participated in
a five-state conference sponsored by the Texas Natural Resource Conservation
Commission (1995). They planned and conducted the first Louisiana Environmental
Education Symposium held in Baton Rouge in 1996. Participants heard presentations
and saw demonstrations by over 50 teachers, university faculty, agency staff, and
industry supporters. (Louisiana Environmental Education Interagency Committee,
1996) The Governor’s Office of Environmental Education and the Louisiana
Environmental Education Commission assumed responsibility for conducting the
annual Environmental Education Symposiums. (Governor’s Office of Environmental
Education, 1999)

Surveys of Youth and Adult Audiences

There have been a number of surveys conducted to determine level of
knowledge and concern about the environment. These surveys provided some indication
of environmental education subject matter needs.
Arcury and Johnson (1987) conducted a telephone survey of 680 individuals in Kentucky with a 64.3% response rate. About 20% of the respondents were able to answer 70% of the nine questions correctly. They reported that these results were similar to results from a national survey conducted in 1980. Respondents to the Kentucky survey scored much higher than the national survey respondents on the subject of acid rain. The authors pointed to local publicity on acid rain because of Kentucky’s coal mining industry as a probable reason for their increased awareness. Respondent’s level of education and income were positively correlated, and being female, was negatively correlated with environmental knowledge. Age and metropolitan residence were not strongly correlated with environmental knowledge.

Gigliotti (1992) surveyed 1,018 Cornell University students about their willingness to give up specific items and compared their responses to the responses of students to similar surveys conducted 10 and 20 years earlier. He concluded that these students were less willing to make personal sacrifices. Gigliotti felt that people must realize the connections between their lifestyles and environmental problems, and that they must be helped to understand the desired behavior and the benefits to them of adopting the new behavior.

The National Geographic Society (1993) sponsored a survey by the Roper Organization of 1,000 adults and 291 youth. It indicated that 75% want to know more about fresh water. All ages considered fresh water pollution among the most serious concerns facing the next generation. Most said that protecting fresh water should be a national priority and that they would be willing to spend money to keep water clean and available. Most felt that business, industry and government should do more to protect
water, but only about a third felt that individuals should do more. Few had taken steps to improve water quality or conserve water. Youth answered 2.8 of 10 questions about water correctly and adults answered 3.3 questions correctly. Less than half the youth felt that they had been taught much about fresh water in school.

The National Environmental Education and Training Foundation (1994), commissioned a survey by Roper Starch Worldwide, Inc. The survey was an effort to learn about environmental knowledge, behavior and attitudes among youth with emphasis on youth from disadvantaged neighborhoods. Phase I of the study was qualitative, consisting of 9 focus groups in New York, Chicago and Los Angeles. These groups provided data for developing hypotheses to be tested in the Phase II quantitative survey. A total of 982 youth were provided questionnaires in their English classes. Classes included grades 4-12 from schools selected proportionate to enrollment. Disadvantaged status was determined from Zip Code and census data.

The Phase II survey found that fear about harm to the environment ranked 3rd overall behind AIDS and kidnaping. Youth from disadvantaged areas ranked it 5th compared to 2nd for youth from non-disadvantaged areas. Youth from disadvantaged areas rated damage to the ozone layer, lead poisoning from water and old paint, and a lack of energy as most important while other youth rated destruction of the rain forest, endangered plants, animals and insects, and destruction of wetlands as most important. The survey found that most youth said they knew a lot or a fair amount about environmental issues, and attributed a similar level of knowledge to their parents, but said they learned only a little or practically nothing about environmental issues in school. Sources of information included television (74%), schools (50%), newspapers
(31%) and family (28%). Shortages of good drinking water, pollution of water from fertilizers and pesticides, and lead poisoning from water and old paint were named by youth from disadvantaged areas as problems more frequently than by other youth. Behaviors noted by the survey included saving energy by turning off lights named by 78% of youth as a step they take to aid the environment. Recycling bottles and cans (69%), saving water (67%), and reducing litter (65%) were also named frequently. 

(National Environmental Education and Training Foundation, 1994)

Warren (1994) reported a national survey of children age 6 to 17 by Environmental Research Associates which found the environment topping the list of biggest problems in our country. Parents ranked the environment sixth.

Better Homes and Gardens (BH&G) magazine polled their readers and more than 10,000 readers and over 1,000 sixth and seventh graders responded. The BH&G readers identified water pollution as the country's worst environmental problem, followed by deforestation, air pollution and smog, ozone depletion, nuclear wastes, landfill over crowding, development/urban sprawl, toxic waste disposal, species extinction, global warming, indoor air pollution, acid rain, and power-line radiation. When asked who is the household environmental expert, 76% responded that the mother was. Actions taken to help the environment included: recycling (84%); using low-phosphate detergent (63%); reducing usage of lawn chemicals (62%); using low-flow faucet and shower heads (56%); driving a fuel-efficient car (55%); and regular use of public transportation (11%). Environmental groups were the most trusted source of information (52%), followed by schools, news media, government and the business community. Most (77%) felt environmental laws and regulations were not strict enough
but few were interested in paying more for environmental improvements in products. When asked which groups were responding better to environmental concerns, they rated agriculture first, followed by citizens, corporations and businesses, and the government. (Cooper, 1994)

The American Water Works Association (AWWA) commissioned a survey by Apogee Research, Inc. In a random telephone sample of 1,603 adults most rated the quality of their drinking water as good or excellent (62%), and believed it met or exceeded (73%) federal standards for quality and safety. The AWWA survey asked respondents to choose a level of water safety between 0 and 100 with 100 being extra safe water. The average choice was 93.6 with their rating of current supplies as 75.9. Nearly half reported drinking bottled water some of the time while more than half reported drinking only tap water. Reasons given for drinking bottled water included worry about the health and safety of tap water and as a substitute for other beverages. Nearly half said bottled and tap water were equally safe, 37% felt bottled water was safer, and 10% felt tap water was safer. When asked how much they trusted their local water utility, 33% said very much, and 53% said somewhat. (Galbraight, 1994)

About three weeks after the AWWA survey was conducted, Milwaukee residents were informed that their drinking water had been contaminated by a waterborne parasite called Cryptosporidium, and that they should boil the water before consumption. The AWWA had Apogee Research, Inc. conduct a follow up survey with 507 of the original respondents and with 400 Milwaukee residents six weeks after the outbreak. There was little change in the responses from the original respondents. Of the Milwaukee respondents, 65% rated their drinking water as excellent or good. Most of
the Milwaukee respondents believed their water met or was better than (78%) federal standards. In the original survey, 82% said they were very or somewhat willing to pay higher water bills to bring water quality up to federal standards. In the Milwaukee survey, 69% said they were very or somewhat willing to pay more. Most of the Milwaukee respondents said local officials did an excellent or a good (79%) job of telling the public what to do when the outbreak occurred. About half said officials did an excellent or good job of telling the public quickly. (Galbraight, 1994)

LaPrade (1994) described results of a random telephone survey of 202 people in the Flint Creek Watershed of North-Central Alabama. The survey was intended to determine residents' perception of the environmental status of their community. LaPrade reported 69% of respondents indicated they would be more actively involved in protecting water quality but weren't sure where to start. LaPrade reported that 76% had never received formal education about the environment and 93% would appreciate receiving environmental education.

Gambro and Switzky (1996) analyzed data from the Longitudinal Study of American Youth to determine environmental knowledge of 2,900 high school students. They found that most students were aware of basic facts concerning environmental issues but could not apply their knowledge to understand the impacts of or solutions to the issues. The authors recommended instructional techniques that provided a problem-oriented context for learning.

The Water Quality Association reported one-fifth of 1,003 adults surveyed by Opinion Research International were dissatisfied with the quality of their household water supply. Nearly one-half wanted additional information but nearly one-fourth did
not know whom to contact for information. About one-third used a home water
treatment device other than bottled water. (Censky, 1997)

The National Environmental Education and Training Foundation (1997)
commissioned Roper Starch Worldwide to conduct The Sixth Annual Survey of Adult
Americans. The survey found gender and age differences in correct responses to
questions about the environment. Men gave correct answers more frequently than
women which they suggested might be attributed to more science training for men. The
45-54 year age group gave correct answers most frequently followed by the 35-44 year
age group. The survey found less than one-fourth of the respondents were aware that
nonpoint source runoff was the primary source of water pollution. Nearly half thought
factories were the primary source of water pollution. Nearly two-thirds believed that
environmental protection and economic development can coexist. Those with higher
levels of environmental knowledge and higher levels of education were more likely to
believe that the environment and the economy could coexist. When asked their choice if
a compromise could not be reached, 69% chose the environment and 15% chose
economic development. Women tended to choose the environment more frequently than
men. When asked if environmental regulations had gone too far or not far enough, 46%
chose not far enough and 17% chose too far. Women chose not far enough more
frequently than men and rural residents chose too far more frequently than urban
residents. Southerners chose not far enough more frequently than did the respondents
from any other region.

Gross (1996) conducted a survey of California water agencies to determine
perceptions of the water industry by its workers and how recycling fits into water
resource planning. About half of the water agency respondents reported the public thinks its drinking water is safe. About 31% of the water agency respondents felt that people in their customer area consumed a high percentage of bottled water. About three-fourths of the water agency respondents said their agency worked closely with other agencies and had a public outreach program. About half the respondents said their agency held public hearings on future water supplies, and worked closely with the media and environmental groups. Only about one-fourth of the respondents said their water agency had an educational school program.

The National Environmental Training Center for Small Communities surveyed local officials and engineers to determine training needs for those providing water and waste water service for communities with less than 10,000 population. Elected officials ranked understanding the basics of environmental systems management as their highest training need followed by financial management and planning. Wastewater and drinking water engineers ranked how to work with small communities highest while solid waste engineers ranked developing public relations highest. Waste water, drinking water and solid waste officials ranked understanding small community dynamics and financial management highest followed by public communication and presentation skills.

(National Environmental Training Center for Small Communities, 1994)

The Colorado Pollution Prevention Partnership (1994) commissioned a random telephone survey of 300 small and medium-sized (fewer than 500 employees) Colorado businesses. Respondents included 20-24 businesses in each of 14 Standard Industrial Classification codes. Nearly 80% responded that they were familiar with pollution prevention and about half chose source reduction as the most descriptive of eight
definitions of pollution prevention. About 65% reported use of chemical substitutes and 45% reported soy- or water-based solvents had been chosen to reduce the amount of petroleum-based solvents they used as inputs to their operations. Businesses depended on suppliers (37%), publications (30%) and other companies (24%) for information, and rated workshops, newsletters, magazines and site visits as equally useful. They did not like information clearinghouses and some noted an antagonistic relationship with government as a barrier. Less than 10% agreed that regulations were easy to understand and less than 20% agreed that government was a good place to go for help.

Approximately 22% of respondents indicated that moral or ethical reasons were the primary motivators for pollution prevention. Another 16% gave government monetary incentives and about 13% listed profits as their reasons.

Nowels (1994) reported that Dealer Progress magazine developed and implemented an Environmental Respect Awards program for agri-chemical businesses in 1991. A self-audit booklet made up of 101 questions covering management of agri-chemicals at retail establishments was sent to 7,500 owners, operators, or managers of retail outlets in the United States in 1994. Nearly 4,500 completed booklets were returned for analysis. Of those storing liquid pesticides and fertilizers, 96% reported that pesticide bulk storage tanks and 67% reported that fertilizer bulk storage tanks were enclosed by leak containment systems. When asked if they had provided information to help educate their neighbors about agri-chemicals, 55% responded that they had.

Lanyon, Kieman and Stoltzfus (1996) used focus group interviews of Pennsylvania agricultural chemical dealers and farmers to determine the reason for low participation in nutrient management and integrated crop management (ICM) programs.
They found that dealers viewed farmers as being interested in water quality and in how to avoid nutrient management problems, but they felt the farmers were more concerned with the potential of government control of farming practices, and that local religious groups resisted government programs. The dealers felt that farmers viewed the ICM purpose as cutting pesticide use while the farmer’s purpose was cutting pesticide costs. Dealers believed some of the farmers’ cultural practices were consistent with ICM objectives but the farmers were intimidated by the formality of the ICM program. The dealers were not interested in participating in an experimental government program which might be short-lived. The dealers were concerned that if they started charging for some of the services they were already providing, they might lose some customers. The dealers were interested in the ICM program because it demonstrated their willingness to support water quality programs.

The farmers believed protecting water quality was important. They were concerned about water quality for their dairy animals and their families. Some farmers had bought water treatment systems or bottled water. They had minimized pesticide use to cut costs. Some had experimented with reduced nitrogen fertilizer use. They expressed reluctance to participate in an inefficiently-run government program which could lead to additional regulations. The farmers were not concerned about paying for ICM or dealer services as long as they could justify the value of the services. They felt that this would make it easier for them to compare dealers, and they would pay more for a product from a dealer who provided good services. (Lanyon, Kiernan, Stoltzfus, 1996)

The authors concluded that the extension service needed to facilitate dealer business management decisions and to provide dealer ICM certification that would be
recognized by the farmers. They concluded that government regulators needed to be trained to recognize alternative approaches to achieving water quality goals which would provide the farmer with flexibility in making decisions. (Lanyon, Kieman, Stoltzfus, 1996)

Sandoz Agro, Inc. (1993) commissioned the Gallup Organization to conduct a telephone poll of a random sample of 1,200 U.S. farmers, between the ages of 18 and 65, who were farming at least half-time, and who farmed 240 acres or more. The individual interviewed was the male or female head of the household. When asked for the most serious environmental problem associated with agriculture, 29% of the farmers chose contamination of surface and ground water by pesticides and fertilizer, 14% chose contamination of soil by pesticides and fertilizer, and 10% chose chemicals/pesticides being used. Soil erosion received 10% of the responses. When asked what the typical consumer thinks are the most serious agriculture-related environmental problems, 35% of the respondents chose contamination of surface and ground water by pesticides and fertilizer, 15% chose contamination of soil by pesticides and fertilizer, and 7% chose chemicals/pesticides being used. When asked for the best way to reduce the public's concern about environmental issues associated with agriculture, 68% of the responses were to increase public understanding/education. When asked who has primary responsibility for education of the public about farmers and their environmental actions, 29% of the respondents said farmers and 24% said the government. Farmer efforts to educate the public included talking to people (21%), the Farm Bureau (15%), organized farmer groups (15%), and speaking with children in schools (11%). (Sandoz Agro, Inc., 1993)
Drost, Long, Wilson, Miller and Campbell (1996) used a mailed questionnaire to determine barriers to adoption of more sustainable farming practices in Utah. A total of 634 surveys were returned out of 964 mailed. The farmer population in Utah was believed to be 7,009. Responses from absentee owners and those not farming were eliminated. Of the 351 responses analyzed, 40% used minimum tillage, 19% used no-till, 41% used fallow periods, 56% used cover crops, 31% used double cropping, and 86% used long term crop rotations. Of the same respondents, 70% had not reduced chemical usage in the past three years, 52% did not credit alfalfa plow down, 45% did not credit animal manure application when deciding how much fertilizer to apply, 42% did not use soil tests, 76% did not conduct field trials, and 91% did not use strip tests to determine crop nutrient needs. Most farmers believed sustainable practices were too costly and that they were farming sustainably or they would not still be in business. They needed more time, information, different equipment and management to make sustainable systems practical. Most of the respondents considered themselves interested in being good stewards of the land, in maintaining the quality of life and the health of their families, and in the continuity of the family farm. Many felt they were being pushed by the government and environmentalists to make changes that were neither necessary nor feasible.

Petrzelka, Korsching and Malia (1996) compared the attitudes of 151 members of Practical Farmers of Iowa with their agricultural practices. Attitudes in favor of sustainable agriculture were not predictive of their use of chemical inputs. Increased use of conventional agriculture sources of information was positively related to increased use of chemical inputs. The authors suggested that educational programs should provide
farmers with information on the personal, family, community and societal benefits of sustainable agriculture and that public policy education on sustainable agriculture is needed for leaders of public and private institutions supporting agricultural research and outreach.

Surveys of farmers and agri-business people indicate awareness of negative attitudes of the general public about agricultural chemicals. Agri-business has taken steps to comply with regulations and reduce their exposure to criticism. Farmers have taken some steps to reduce their contributions to environmental pollution. There have been other “survey” efforts conducted by the U. S. Environmental Protection Agency which involved agency professionals as participants and as such would presumably give an indication of subject matter needs based on the science available to them and the experience of the staff involved in the survey.

**Comparative Risk Surveys**

Lee M. Thomas, Administrator of the U. S. Environmental Protection Agency (1987 a,b,c,d,e), asked a task force of 75 career staff members to examine relative risks to human health and the environment posed by various environmental problems. Comparing risks posed by environmental issues was viewed as a means of establishing priorities for funding and policy decisions. The task force worked nine months to evaluate and rank the relative risks posed by 31 environmental issues. They established four work groups to consider different types of risk for each issue: cancer risk; non-cancer health risk; risk to the ecology; and risk to welfare (visibility impairment, materials damage, etc.). They found that the rankings by risk did not correspond well with their program priorities. Areas of relatively high risk but low effort included:
indoor radon and other indoor air pollution; stratospheric ozone depletion; global warming; nonpoint source water pollution; discharges to estuaries, coastal waters, and oceans; other pesticide risks; accidental releases of toxics; consumer products; and worker exposures. Areas of high effort but relatively medium or low risks included: industrial solid waste sites; Superfund sites; underground storage tanks; and municipal, non-hazardous waste sites. Priorities appeared to be more closely aligned with public opinion than with the estimated risks. The U. S. Environmental Protection Agency (1989a) had ten geographic regions which exercised some level of autonomy in their conduct of environmental programs. The regions were encouraged to conduct their own comparative risk analysis. Regions 1, 3 and 10 found that their rankings were generally similar to the national study with some regional variations.

In 1990, the staff of the U. S. Environmental Protection Agency Region 6, which included the states of Arkansas, Louisiana, New Mexico, Oklahoma and Texas, conducted a comparative risk survey similar to the national survey. They used three workgroups to evaluate environmental issues important to the five states. The Ecological Workgroup evaluated 22 environmental issues using a mathematical model to compare risks in a large number of ecoregions of the five states. They grouped the issues into four categories of risk from highest to lowest. They determined that conversion of terrestrial ecosystems to agriculture and forestry posed the greatest threat and placed it in the highest risk category. The Human Health Workgroup evaluated 24 issues and ranked them for cancer and non-cancer health risk. They combined the two risks for each issue into four joint risk categories. (U. S. Environmental Protection Agency, 1990 a,b,c)
Louisiana was the fifth state to conduct a comparative risk survey. The Louisiana Department of Environmental Quality (LDEQ) received a grant from the U. S. Environmental Protection Agency to conduct a comparative risk survey of environmental issues important to Louisiana. The project was called Louisiana's Environmental Action Plan (LEAP) to 2000. Most of the work during 1990 and the first half of 1991 was done by three committees. A Technical Committee composed of scientists and technical experts from ten departments and Louisiana State University was divided into three work groups to evaluate 33 environmental issues in terms of their impact on human health, on ecological systems and on the quality of life. A Public Advisory Committee of 35 members was established representing business, industry, government, environmental groups and civic organizations. A Steering Committee was formed of representatives of the administrators of 12 departments, the U. S. Environmental Protection Agency Region 6 and the U. S. Environmental Protection Agency. The Public Advisory and Steering Committees took the Technical Committee's evaluations and combined them into a provisional ranking of issues. At an all-day Summit on the Environment held in Baton Rouge on Saturday, April 20, 1991, the work of the committees was reported to the public. Those attending broke up into small groups, reviewed the provisional rankings and expressed their feelings about the issues. Eleven Town Meetings were subsequently held in the evenings at locations throughout the state. Participants were invited to express their opinions about the provisional ranking and add additional concerns. The public input was used by the committees to develop a final ranking of 35 issues grouped into three classes: Issues of Highest Statewide Risk; Issues of High Statewide Risk; and Issues of High Localized Risk.
and/or Continuing Concerns. The Issues of Highest Statewide Risk were to be reviewed to determine strategies for addressing them (Louisiana Department of Environmental Quality, 1991).

The U. S. Environmental Protection Agency and the U. S. Environmental Protection Agency Region 6 comparative risk studies involved only agency scientists and technicians. Louisiana obtained public participation in the study. This could have led to a more informed public demand for legislators to fund increased efforts directed at the highest risks based on the best information available. This public involvement may have resulted in a different ranking than would have occurred with only agency professionals involved.

Survey of Environmental Education and Literacy in Louisiana

Hair (1994) developed a survey for the Louisiana Environmental Education Commission to be used in describing environmental education programs and determining the level of environmental literacy in Louisiana. He designed separate instruments for business/industry, teachers in primary and secondary schools, students in primary/secondary schools, and university students. The instruments determined experiences with environmental education programs and needs for program support. The survey included 38 descriptions of environmental threats which covered most of the LEAP issues. Hair tested the survey with 52 East Baton Rouge Parish business people, 100 teachers (23 from East Baton Rouge Parish and 77 from 30 parishes other than East Baton Rouge), 101 LSU students, and 193 high school and middle school students from East Baton Rouge Parish. Results indicated that availability of environmental education courses varied widely by parish, with higher availability in East Baton Rouge Parish. In
many schools, elements of environmental education were incorporated into other courses. LSU students reported they did not have access to many environmental education opportunities. Neither set of students rated their exposures very highly. Teachers had some access to limited training in environmental topics and little funding or other resources to support their teaching of environmental topics. Current programs were not viewed as effective in preparing students or the public to deal with contemporary environmental issues or in changing behaviors and/or attitudes. Hair concluded that there were opportunities for business, industry, government, universities and volunteer groups to work together in support of environmental education in Louisiana.

Extension Service State Issues Surveys

State extension services conducted issues surveys of their audiences to determine subject matter priorities for educational programs. Listings of issues submitted by 36 states in response to Baker's survey followed a variety of formats. Issues such as environmental quality, waste management, soil conservation and water quality were listed 43 times which was the second highest frequency grouping. The highest frequency was family issues which were listed 47 times. Issues such as conservation of natural resources, energy conservation, marine and freshwater resources, and natural resources management were listed 14 times. (Baker, 1992)

Webb (1987) reported that the Clemson University Extension Service began their search for issues in 1986 with county problem identification committees. Over 1,000 citizens listed 1,803 different concerns. These were summarized and listed by priority. Results were then presented to more than 5,000 people in a series of meetings.
held to review plans for solving these problems. Extension formed 20 teams to develop education programs for each of the major areas of concern. None of the 20 areas was an environmental issue although environmental topics were included in some areas. Home grounds was one of the areas, and it included an objective of teaching homeowners to use and dispose of pesticides properly. Land and water resources was one of the areas, and it included training 1,300 coastal landowners on the impacts of legislation concerning wetlands and development. Poultry management systems was an area including several objectives related to poultry waste management.

Honnold (1988) reported that the University of Vermont Extension Service began their issues survey process with personal interviews of 400 key leaders asked to identify the needs, problems and concerns facing citizens of Vermont. This led to the development of a survey which was mailed to a random sample of 5,000 residents of Vermont asking them to indicate priorities. Following compilation of the survey results, a public forum was held in each county. The result of these efforts was a list of seven issues. One of the issues, improving environmental quality, included improving water quality, managing pests and pesticides, managing and conserving soil and water resources, and increasing young people's understanding of the environment.

Florell (1990) reported that Nebraska developed a survey form asking citizens to list the major issues/concerns facing their county, the state, and the nation/earth during the next five years. A total of 930 surveys were completed. They including 164 by extension faculty and 766 by leaders. Issues facing counties were grouped into categories (frequency of listing in parentheses): economic (871); sociological (819); environmental (608); demographic (128); political (90); specific agricultural (82); and
infrastructure (52). Issues facing the state included: economic (899); environmental (704); political (388); sociological (296); demographic (105); specific agricultural (103); and infrastructure (42). National or global issues included: economic (765); environmental (599); sociological (425); political (310); demographic (42); specific agricultural (31); and infrastructure (7). The environmental listings included waste management, water quality, air quality and conservation of natural resources.

Bolen (1990) reported that the University of Nebraska Cooperative Extension created seven Priority Initiatives. Two of the Priority Initiatives dealt with environmental issues. Enhancing Water Quality included providing a safe and adequate domestic water supply, and reduction of nitrates, pesticides and other synthetic organic contaminants in ground water. Conserving and Managing Natural Resources included reducing soil erosion, promoting management practices which conserved water, and improving efficiency of rangeland and ranch management.

Carpenter (1989) reported that two of the Texas issues identified in their survey were water quality and conservation, and environment and natural resources. Five of the Texas initiatives subsequently established included: water use efficiency in agriculture; water use efficiency in homes/landscapes/industry; water quality management; proper use of chemicals in the environment; and solid and hazardous waste management.

House and Greenway (1992) sent survey forms to extension Agriculture and Natural Resources (ANR) specialists and program leaders across the United States to determine their expectations about the need for education programs on wetlands and endangered species. The specialists and program leaders then sent survey forms to other extension faculty for responses. A total of 1,192 extension educators received survey
forms. No follow-up was used and 558 responses were received. House indicated that respondents appeared representative of extension educators in the United States likely to work with wetlands and/or endangered species issues. Most (60%) were specialists, 30% were agents and 10% were administrators. House reported that wetlands definition and regulations, property rights, chemicals, and development received mean ratings of 4 on a scale of 1 (cold) to 5 (hot). When asked what commercial or public activities were likely to generate these issues, agriculture (81%), water (67%) and forests (49%) received the most responses.

Baker (1992) reported 1,102 individual participants in 64 Louisiana parish advisory councils. Traditional extension advisory participants made up less than 30% of the total number of participants. They identified an average of nine issues in each parish. The top three issues in each parish were aggregated into a state list. The state list of 61 different issues were grouped into four categories: environment; family; education, government, and services; and economic and community development. The environment category included: water quality (38 parishes); solid waste reduction and disposal (25 parishes); litter control and education (19 parishes); safe use and/or disposal of chemicals/ag runoff (10 parishes); community beautification, improvement, and pride (11 parishes); coastal erosion and wetland preservation (11 parishes); pollution and protection of the environment (13 parishes); recycling (9 parishes); air quality (11 parishes); and drainage and flooding (4 parishes).

Baker (1992) reported 1,102 individual participants in 64 Louisiana parish advisory councils. Traditional extension advisory participants made up less than 30% of the total. Participants identified an average of nine issues in each parish. The top three
issues in each parish were aggregated into a state list. The state list of 61 different issues were grouped into four categories: environment; family; education, government, and services; and economic and community development. The environment category included: water quality (38 parishes); solid waste reduction and disposal (25 parishes); litter control and education (19 parishes); safe use and/or disposal of chemicals/ag runoff (10 parishes); community beautification, improvement, and pride (11 parishes); coastal erosion and wetland preservation (11 parishes); pollution and protection of the environment (13 parishes); recycling (9 parishes); air quality (11 parishes); and drainage and flooding (4 parishes).

In 1999, extension faculty conducted Open Forums in all Louisiana parishes. Participants were asked to identify critical things that would need to be addressed in the next three to five years for them to realize the future they desired for themselves, their families, and their communities. A total of 2,207 parish residents participated in 63 Open Forums for an average of 35 participants per parish. The total number of issues reported was 764, for an average of 12 issues per parish. A total of 61 issues were related to the environment or 8% of the total number of ranked parish issues. (LSU AgCenter, 2000)

Agricultural Water Quality Issues

The U. S. Environmental Protection Agency (1994) reported that two-thirds of assessed water bodies met the Clean Water Act goals established by Congress. Agricultural runoff was cited as the most extensive source of pollution for the water bodies which did not meet the goals. Nutrients, siltation and organic enrichment were listed among the five leading causes of water quality problems in rivers, lakes and
estuaries. Pathogens was also listed for rivers and estuaries, pesticides for rivers, and suspended solids for estuaries.

Total Maximum Daily Loads have been calculated by LDEQ for the Mermentau and Teche watersheds in Louisiana. Cormier suggested that 50% to 70% of the oxygen demand in runoff to those surface waters must be eliminated in order to meet water quality standards. Whether or not those reductions could be obtained was not clear to Cormier. (Dunne, 1999)

The Natural Resources Conservation Service (NRCS) reported that one-third of crop land acres were threatened by soil erosion and that over 200 million acres surveyed in 1992 needed one or more conservation practices. Over 150 million acres of forest land and nearly 60 million acres of pasture land needed conservation practices. (U. S. Department of Agriculture, 1996b)

Meals, Sutton and Griggs evaluated progress in 16 USDA water quality projects during FY 1991-94. Half of the projects were Hydrologic Unit Areas and half were Demonstration Projects. Each was designed to reduce nonpoint source water pollution by farmer adoption of conservation practices. Indicators reviewed included producer adoption of conservation practices, agency staff competency in use of simulation models, and monitored changes in water quality. The projects reported substantial adoption of conservation practices. Nutrient, pesticide, animal waste and irrigation water management, conservation cropping and tillage, and use of cover/green manure crops were the most widely adopted national practices. Six project annual reports demonstrated high staff levels of skill in use of field-scale simulation models and three projects demonstrated high staff levels of skill in use of watershed-scale simulation.
models. Four projects demonstrated water quality impacts through monitoring. The five year time period for the projects was considered to be too short to establish baseline conditions, establish a control area and implement practices on the treatment area, and wait for the system to respond. The authors recommended cooperation with other programs which could provide monitoring, better selection of project areas and programs to facilitate monitoring. They recommended establishment of a USDA conservation practice installation, operation, and maintenance tracking system both for project participants and for farmers operating outside USDA programs. (U. S. Department of Agriculture, 1996d)

Woodward, et al. (1994) reported results of five projects designed to evaluate and develop profitable cropping systems to protect water resources. The Management Systems Evaluation Areas (MSEAs) were located in the Midwest. Research and extension efforts were closely integrated. During the FY 1991-94 reporting period, over 700 education programs delivered information to 50,000 users annually. Research conducted as part of the Iowa MSEA found that nitrates leached through glacial till were converted to nitrogen gas, that best management practices reduced leaching to shallow ground water, and that herbicides were more of a threat to surface water than to ground water. These local research results allowed the development of an area-specific education program which was delivered to farmers. The Missouri MSEA was conducted on an 18,000 acre watershed with a clay pan which caused 30% of the precipitation to run off. Farmers identified abandoned water wells as a water quality concern. An education program was developed and implemented. Over 1,100 abandoned water wells were plugged in four years. The drinking water standard for nitrate was exceeded in
25% of the samples from shallow monitoring wells. Research demonstrated that nitrogen fertilizer application in a given field could be reduced 5% to 15% by using variable-rate technologies. (Woodward, et al., 1994)

Adoption of more efficient furrow irrigation systems by farmers in the Nebraska MSEA has reduced water use by 10%. Installation of 730 surge irrigation systems could have reduced annual nitrogen leaching by 690,000 pounds. Improved irrigation management was expected to reduce nitrogen leaching by another 46,000 pounds annually. The Northern Cornbelt Sand Plain MSEA demonstrated that nitrate concentrations below sandy soils could be minimized with careful management. Nitrogen usage in the Anoka Sand Plain of Minnesota has been reduced by 16%. Educational efforts in the Ohio Buried Valley MSEA resulted in a 12% increase in use of no-till systems, making it the most used form of conservation tillage in the four-million acre basin. Monitoring in the basin demonstrated a 2.5 parts per million decline in average nitrate concentration in surface water during the FY 1991-94 reporting period. (Woodward, et al., 1994)

**Sustainable Development**

Sustainability on a global scale would appear to be a reasonable goal of environmental education. There have been several discussion of sustainable development which may serve as appropriate subject matter for environmental educators. Disinger (1990) reviewed the connections between environmental education and sustainable development and suggested that recognition of the value of sustainable development and overcoming the resistance to interdisciplinary education must occur before environmental educators would embrace sustainable development.
The National Science and Technology Council (1994) initiated a discussion on the role of the federal government in fostering the development and implementation of environmental technologies which would enhance sustainable development. They saw a need to shift from a philosophy of waste management to one of pollution prevention and more efficient resource use. They divided environmental technologies into: those that avoid the generation of wastes; those that allow the monitoring and assessment of pollutants and environmental quality; those that control wastes and render them harmless before they enter the environment; and those that remediate pollutants after they enter the environment, or that restore degraded ecosystems. The Council listed key policy areas including research and development, demonstration, partnerships and collaboration, education and training, and information dissemination. Key audiences for education and training were listed as students from K-12th grades through advanced graduate levels, employees of environmental technology producers and of environmental technology users, and the general public. The Council would support efforts to increase the appreciation among citizens of the importance of the environment and sustainable development to their lives and to build a highly-trained work force which could develop, maintain and operate environmental technologies. Information dissemination would target people in government, industry, non governmental organizations and academia.

Federal FY94 funds for environmental technology totaled $4 billion. The US Department of Agriculture’s share of the total was about 7.4%. A substantial portion of the funds for education and training were USDA expenditures by the Soil Conservation Service, the Forest Service and the Extension Service. Area wide programs supporting
Integrated Pest Management were listed as an example. A partnership such as the cooperative extension service was listed as a next step for education and training although it was considered a relatively expensive approach for information dissemination. The Council suggested the use of cost-benefit analysis, life cycle analysis, risk assessment, and ecological evaluation as tools to help in the understanding of environmental and economic relationships. The need for improved agricultural technologies for reducing soil erosion, greenhouse gas emissions, chemical-based pest management and plant nutrient supplies, for improving regeneration of forests and wildlife habitat, and for producing biomass was noted. (National Science and Technology Council, 1994)

After a year of discussions and conferences on the subject, the National Science and Technology Council (1995) issued a National Environmental Technology Strategy. The strategy included five themes. The Performance, Flexibility and Accountability theme involved changing U. S. Environmental Protection Agency policies to encourage environmental technology development. The Innovation for Environmental Results theme involved encouraging new technology implementation which would improve productivity and reduce resource use. The Commercialization theme involved improved access to capital and export markets by environmental technology developers. The Sustainable Community theme involved improving the quality of life while reducing resource inputs. The Learning and Working Together theme involved improving collaborative approaches to infusing environmental education into all grade levels. The basis for the Council’s support for environmental education was that it was necessary for achievement of sustainable development. Present departmentalization along subject
matter lines was recognized as a barrier to inter-disciplinary efforts to develop and implement sustainable technologies.

The President's Council on Sustainable Development (1996a) conducted a demonstration project called the National Forum on Partnerships Supporting Education About the Environment in 1994. The product of the forum was reported as Education for Sustainability: An Agenda for Action. The report focused on six themes including lifelong learning, interdisciplinary approaches, systems thinking, partnerships, multicultural perspectives, and empowerment. One of the recommended actions was the establishment of an extension network to enhance the capacity of individuals, workforces, and communities to live sustainably. It suggested the Cooperative Extension Services, the Sea Grant, the Space Grant and the Manufacturing Extension Services as models to follow. Such a network might be called the Sustainable Development Extension Network. Examples of existing programs included extension service programs in Connecticut, Florida, New Jersey, New York, and Wisconsin.

The President's Council on Sustainable Development (1996b) published the results of the work of ten task forces as Sustainable America: A New Consensus for Prosperity, Opportunity, and a Healthy Environment for the Future. They agreed on ten goals. The health and the environment goal ensured that every person enjoyed the benefits of clean air, clean water, and a healthy environment at home, at work and at play. The economic prosperity goal implied a sustained healthy United States economy that grew sufficiently to create meaningful jobs, reduce poverty, and provide the opportunity for a high quality of life for all in an increasingly competitive world. The equity goal ensured that all Americans were afforded justice and had the opportunity to
achieve economic, environmental, and social well-being. The conservation of nature goal implied that citizens used, conserved, protected and restored natural resources, such as land, air, water, and biodiversity, in ways that helped ensure long-term social, economic, and environmental benefits for themselves and future generations. The stewardship goal encouraged individuals, institutions, and corporations to take full responsibility for the economic, environmental, and social consequences of their actions. The sustainable communities goal encouraged people to work together to create healthy communities where natural and historic resources were preserved, jobs were available, sprawl was contained, neighborhoods were secure, education was lifelong, transportation and health care were accessible, and all citizens had opportunities to improve the quality of their lives. The civic engagement goal created full opportunities for citizens, businesses, and communities to participate in and influence the natural resource, environmental, and economic decisions that affected them. The population goal encouraged the United States to move toward a stable population. The international responsibility goal implied taking a leadership role in the development and implementation of global sustainable development policies, standards of conduct, and trade and foreign policies that further the achievement of sustainability. The education goal ensured that all Americans had equal access to education and lifelong learning opportunities that prepared them for meaningful work, a high quality of life, and an understanding of the concepts involved in sustainable development.

The Council said that information and education, in both formal and nonformal spheres, had a tremendous potential for increasing citizen awareness and ability to engage in decisions affecting their lives. The keys to this strategy were managing...
information better, expanding access to the decision process, measuring progress toward societal goals more comprehensively, and incorporating accounting measures that educate and enable decision makers and individuals to make decisions that are more economically, environmentally, and socially sustainable. The Council said the country’s formal education system must be reformed to better address sustainability, and nonformal education forums and mechanisms must be tapped to promote opportunities for learning about sustainability. The Council said that building a knowledge of the interdependence among economic prosperity, environmental protection, and social equity would help citizens understand, communicate, and participate in the decisions that affected their lives. They defined education for sustainability as the continual refinement of the knowledge and skills that lead to an informed citizenry, that is committed to responsible individual and collaborative actions, that will result in an ecologically sound, economically prosperous, and equitable society for present and future generations. The principles underlying education for sustainability included strong core academics, understanding the relationships between disciplines, systems thinking, lifelong learning, hands-on experiential learning, community-based learning, technology, partnerships, family involvement, and personal responsibility. (President’s Council on Sustainable Development, 1996b)

The Council said the role of communities was becoming increasingly important as the United States moved toward more decentralized decision making. In sustainable communities, people were involved in building a community together. They were well-informed and actively involved in making community decisions. They made decisions for the long term that benefitted future generations as well as themselves. They
understood that successful long-term solutions required partnerships and a process that allowed for representatives of a community’s diverse sectors to be involved in discussions, planning, and decisions that respond directly to unique local needs. They recognized that some problems cannot be solved within the confines of their community and that working in partnership with others in the region was necessary. (President’s Council on Sustainable Development, 1996b)

The President’s Council on Sustainable Development (1997) published the Public Linkage, Dialogue and Education Task Force Report which was subtitled From Classroom to Community and Beyond: Educating for a Sustainable Future. The report focused on the role played by formal and nonformal education in equipping citizens with the knowledge, skills, and abilities necessary to move our nation towards a sustainable future. Part of the discussion revolved around environmental education which appeared to differ from science education by including a strong social component. Students would not only acquire the knowledge, but also the skills, attitudes, motivations and commitments to address environmental issues. The report mentioned the National 4-H Council’s Environmental Stewardship and workforce preparation initiatives, as well as efforts by extension service faculty in California, Connecticut, Florida, West Virginia and Wisconsin.

Toman and Darmstadter (1996) provided an analysis of the report of the President’s Council on Sustainable Development. They appreciated the report’s recognition of the interactions between environmental, economic and social goals and the concern about the impact of today’s actions on tomorrow’s opportunities. The call for better science and public understanding, cooperative decision making, and
performance-based policies to achieve environmental and resource goals was applauded. They questioned the contention that meeting standards can result in net economic benefits. They would like to have seen more support of basic research and development. They felt the difficulty of obtaining agreement by all stakeholders needed to be emphasized. They pointed out that how serious the problem of sustainable development is and what to do about it are the subject of much debate.

Robert (1997) began a sustainability movement in Sweden in 1988. It looked at the earth as a system using basic laws of thermodynamics as guiding principles. Robert associated holistic thinking about the earth with the systems thinking concepts discussed by Peter Senge and other management consultants. The movement included about 120 corporations and communities in Sweden and was associated with organizations in Australia, the Netherlands, the United Kingdom and the United States.

Hren, Bartolomeo and Signer (1995a) published a guide for community groups in defining community, gathering stakeholders, creating a community vision and developing a plan to build sustainability. A second guide offered a set of readily accessible indicators which could be used by a community to establish a baseline and to determine progress toward achieving sustainability. (Hren, Bartolomeo and Signer, 1995b) Hren and Hren (1996) provided a set of lesson plans that could be used in the classroom to help students in grades 9-12 learn about sustainability and initiate class projects in support of community sustainability. Hren and Bartolomeo (1997) provided guidance for community leaders who want to facilitate a community forum on sustainability.
Sustainable Agriculture

Agricultural practices affect natural resource sustainability. The U. S. Department of Agriculture (1997a) provided natural resource data for the 48 contiguous states. In 1992, 31% of the total land area was in grassland pasture and range, down from 45% in 1945, because farmers had improved forage quality and productivity and had reduced the total number of farm animals, particularly sheep and draft animals. Forest-use land declined from 32% in 1945 to 30% in 1992 while parks, wilderness areas and recreation areas increased from 1% to 4.6% of the total land area. Total crop land remained about 24% of total land area, but crop land used for crops has declined from 19% in 1945 to 18% in 1992 as idled crop land increased from 2% to 3% and crop land used for pasture increased from 3% to 4%. Urban land area increased from 1% to 3% of the total land area between 1945 and 1992 while the population of the United States doubled. A total of 380 of the 663 plant and animal species listed as threatened or endangered as of September 30, 1995, were listed, at least in part, due to activities associated with agricultural development, grazing and chemicals were the primary causes. Agriculture accounted for 81% of wetland loss in the United States between 1954 and 1974 and for 20% of the loss between 1982 and 1992. Runoff from agricultural land accounted for 60% of the sediment and about half of the nitrogen and phosphorus reaching fresh surface waters in 1993. Odors, dust and smoke from agricultural and forestry operations created localized air quality problems. Agricultural production and storage accounted for about 75% of pesticide use in the United States in 1995. Pesticides represented about 4% of total agricultural production expenses and one-third of manufactured input costs. Corn received about 36% of all
agricultural pesticides applied in 1995. Herbicides represented 57% of the active ingredients in all agricultural pesticides applied during 1995 and over 90% of the pesticides used on corn. Atrazine, the most widely used herbicide, was applied to over 40 million acres in 1995. (U. S. Department of Agriculture, 1997a)

Total direct energy consumption, other than electricity, by United States agriculture fell 25% from 1978 to 1993 due to reduced consumption of gasoline, diesel, liquefied and natural gas fuels. At the same time, agricultural output increased by 47%. Precision agriculture technology offered improved efficiency in the use of agricultural chemicals but the cost and complexity of the new equipment restricted its application. Conservation tillage was used on over 100 million acres of crop land, or 35% of planted acres, in 1996. Soil erosion was reduced as much as 90% where crop residue was maintained on fields allowing increased water infiltration. Fuel and labor requirements were reduced and soil quality was improved where conservation tillage was used. The U. S. Department of Agriculture spent $3.2 billion on resource conservation and environmental programs. Two programs, the Conservation Reserve Program and Conservation Compliance were estimated to have reduced soil erosion by 1.2 billion tons in 1995. (U. S. Department of Agriculture, 1997a)

The Agricultural Research Service (ARS) evaluated the effects of elevated levels of greenhouse gases on respiration, photosynthesis and water use by agricultural plants. Many greenhouse growers have used higher levels of carbon dioxide to increase production, but ARS researchers have found that it also stimulated photosynthesis and decreased water usage, even in the presence of higher levels of ozone. Some species responded more to increased carbon dioxide than others. Conservation tillage has been
found by ARS to reduce the loss of carbon from the soil into the atmosphere. They estimated that the 36 million acres of land taken out of production and restored to grasses and trees by the Conservation Reserve Program may be storing as much as one third of all the carbon released into the atmosphere by agriculture. (United States Department of Agriculture, 1997b)

National support for sustainable development has been provided by the federal government and non-governmental organizations. Education for sustainability would appear to be a major theme for any environmental education program.

Organizing and Working With Advisory Groups

One of extension’s traditional methods has been the use of advisory committees to focus education programs on user needs. Advisory committees include stakeholders and take many forms. Verma (1990) reported the Agricultural Waste Management Committee was organized by the Louisiana Cooperative Extension Service in 1969. It included representatives of the LSU AgCenter as well as USDA agencies such as the Natural Resources Conservation Service (NRCS) and the Farm Services Agency. Regulatory agencies such as Louisiana's Departments of Agriculture and Forestry, Health and Hospitals, and Environmental Quality were represented as was industry and the Louisiana Farm Bureau Federation. The committee's technical recommendations have been adopted by the NRCS as specifications for construction, operation and maintenance of animal waste management facilities.

Verma reported that water quality programming was conducted by the Louisiana Cooperative Extension Service under a comprehensive program priority. A Water Quality Task Force was appointed to provide internal coordination. It included
economics, soil science, engineering, 4-H, and home economics specialists as well as agents with agricultural and fisheries assignments, a district agent and the Associate Director. The task force was later replaced with a Water Quality Priority Working Group which included 17 agents and specialists and 14 representatives of various agencies and organizations with expertise and capabilities in water quality issues. (Verma, 1990)

In May, 1989, an evaluability assessment (EA) of the Louisiana Cooperative Extension Service water quality program was begun. Verma described this as a study to determine the scope and depth of an existing program, prescribe improvements, and make evaluations more useful. The EA team included eight Louisiana Cooperative Extension Service faculty, an administrator, and evaluation specialists from the U. S. Department of Agriculture and the Virginia Cooperative Extension Service. The team identified 12 target audiences and listed educational changes desired for each. Changes were grouped according to whether they applied to knowledge, attitudes, skills or aspirations. The team identified 62 stakeholders and conducted a stakeholder survey in 1990 to determine their involvement in water quality issues, their perceptions of future concerns, their need for knowledge and information and their opinion of the role of the Louisiana Cooperative Extension Service in water quality education. The 43 respondents indicated both a need for water quality education and a role for the Louisiana Cooperative Extension Service. The EA team developed a water quality program model and a set of objectives for the program. (Verma, 1990)

Baker arranged focus groups of extension agents and parish advisory council members to evaluate the councils’ effectiveness in identifying and ranking issues of
importance to members. He concluded that, in some parishes, teamwork among
Louisiana Cooperative Extension Service staff needed to be improved and that agents
needed training in filling a facilitation role, in group dynamics, and in selecting and
working with volunteers. He concluded that council members were frustrated at the lack
of follow through on the work of the council. They felt that the broader representation
of parish residents on the councils and the increased contact between faculty and
representatives of local government and other agencies was very important. Baker
recommended that community leaders be more effectively involved in the planning,
development, and evaluation of extension programs, and that faculty be trained to serve
as facilitators. He also recommended training in inter-personal communications, small
group dynamics and volunteer selection, utilization and leadership. (Baker, 1992)

Barnett arranged focus groups of extension agents and cotton advisory
committee members to determine the effectiveness of the committees as perceived by
agents and their clientele. He concluded that while committees strongly influenced
programming, they had only limited influence on program acceptance or evaluation.
Some members suggested that home economics and 4-H faculty could help improve the
public understanding of agriculture and that programs like Ag in the Classroom were
helpful to the industry. There was some feeling expressed that extension had lost
credibility by favoring the boll weevil eradication program. One participant said
extension had too many production people and not enough economists. Barnett
recommended that committees represent a broader cross section of individuals involved
in the industry and that agents be given a better understanding of the advisory
committee process and of committee management. (Barnett, 1997)
The Delphi Method

A less expensive technique for obtaining expert opinion from advisory committees was the Delphi Method. It usually included an iterative, independent polling of individual experts selected to serve on a panel. The first polling might have been an open-ended question asking panelist to list topics which should be included in an environmental education program directed by the Louisiana Cooperative Extension Service to farmers. Upon receiving the panelist’s individual responses, the researcher would have compiled the responses into a list which would be submitted independently to each panelist for rating in terms of importance and for suggestions of additional topics. After receiving the panelist’s individual ratings of the topics and their suggestions of additional topics, the researcher would have summarized the ratings and new topics and would have submitted them to the panelists for a final review. Panelists would be allowed to maintain their initial ratings or change them as a result of their observations of the panel’s combined ratings. This required a minimal expenditure of time on the part of the expert panelists. It allowed each of the experts to vote independently and gave them an opportunity to compare their vote with their peers and to adjust their vote if they chose to do so. (Linstone and Turoff, 1975)

Scheibe, Skutsch and Schofer (1975) suggested that consensus among Delphi panelists was not required. Valuable information could also be derived from observation of disagreement among the experts.

Scheele (1975) suggested that the introduction of ambiguities or disruptions into the process could reduce the tendency of Delphi panelists to converge toward consensus.
Delbecq, van de Ven and Gustafson (1975) suggested that ten to fifteen panelists from a homogeneous group might be an adequate number and that few new ideas would be generated within a homogeneous group once the size of the panel exceeded thirty well-chosen participants. They suggested that a larger group may be useful if one of the purposes was to provide increased group understanding of the subject matter.

**Expansion of the LCES Environmental Education Program**

The U. S. Environmental Protection Agency reported to Congress that nonpoint source was the dominant source of the remaining surface water pollution problems in the United States (U. S. Environmental Protection Agency, 1989b). The largest nonpoint source contaminant in terms of tonnage was soil from erosion of land. Half the land in Louisiana was in timber and a quarter of the land was in agriculture subject to soil erosion. Plant nutrients and pesticides were the second and third largest nonpoint source water contaminants. Agricultural producers were considered the primary users of fertilizers and pesticides. Louisiana farmers and foresters have received negative publicity as contributors to nonpoint source water pollution.

This led the Louisiana Cooperative Extension Service to assume an expanded role in environmental education during the 1980s. Engineers and agronomists have helped fertilizer spreader truck and aircraft operators and pesticide applicators to calibrate and adjust their equipment to improve application uniformity and accuracy for many years. In 1979, an engineer with industrial experience was hired with state funds. He expanded and upgraded the calibration program to include aerial applicators of seed, pesticides and fertilizers. The Louisiana Cooperative Extension Service and industry have provided funds to further upgrade the testing equipment and to allow...
increased testing of aerial and ground applicators. This has resulted in improved application efficiency, reduced pesticide drift, and a more productive, energy efficient and environmentally friendly industry.

In 1988, an engineering specialist on state funds was assigned to work full time on environmental issues. In 1989, a half time associate position was created to work on environmental issues using federal funds. Other specialists in home economics, engineering, agricultural economics and rural development, plant and animal sciences and communications increased the use of environmental considerations in program development and in agent training.

The Louisiana Cooperative Extension Service designated water quality as a program priority in 1989. (Verma, 1990) A five hour training for agents was conducted in eight extension regional locations on the rules and regulations pertaining to drinking water supplies, health effects of drinking water contaminants, and the characteristics of area aquifers and geology. After receiving the training, a home economist found a commercial lab in a nearby urban parish which agreed to test water samples from private wells. She received training in collecting and transporting samples from the staff at the lab. Local officials have referred many rural residents with concerns about their drinking water to her for assistance with testing. On a quarterly basis, she has contacted those who have expressed interest, arranged with them to collect water samples, had the samples tested, and interpreted test results for them. If a problem was indicated by test results, she helped them resolve the problem. (LSU AgCenter, 1998)

A number of energy conservation education programs have been conducted with funding from the U. S. Department of Energy and the Louisiana Department of Natural
Resources. Most of these programs have been targeted at traditional audiences such as greenhouse, fruit, ornamental and vegetable growers, irrigators, aquaculturists, marine fishermen, and residential householders. Others have been targeted at agricultural chemical applicators, cotton gin operators, automobile operators, small business owners, and managers of schools and other public buildings. One program targeted energy conservation through the recycling of agricultural, forestry, and fisheries processing plant, industrial and municipal waste water and solid waste to farm and forest land. This recycling provided benefits to the soil and to the crops from the organic matter, nutrients and minerals contained in the wastes. In addition to energy conservation, it helped reduce costs associated with waste water treatment for discharge into surface waters and/or for dumping of solid wastes into landfills.

New and/or rapidly expanding commodities often needed assistance with waste water management before traditional research could respond. As a result of rapid expansion of the crawfish and alligator production and processing industries, and the need for waste water management recommendations, the Louisiana Cooperative Extension Service applied for and received a U. S. Department of the Interior grant through the Louisiana Water Resources Research Institute in 1989 to sample and test waste water from alligator and crawfish operations. This study resulted in data which allowed less expensive waste water treatment than had been expected from experience with other commodities. (Branch, 1990)

In 1992, the Louisiana Cooperative Extension Service brought an experienced fisheries agent on state funds into the state office to work on coastal and wetlands issues. An Environmental Education Project was created. Contract funds allowed it to
be staffed with several positions. A home economics specialist working in the area of
policy education was assigned 40% to the Environmental Education Project. Three other
home economics specialists conducted environmental education as part of their
programs. (LSU AgCenter, 1993)

In 1993, environmental education programming for youth began to increase. An
existing summer camping program for teens teaching them about coastal and wetland
issues was expanded to four week-long camps, called Marsh Maneuvers, with support
from the Louisiana Department of Wildlife and Fisheries. An Advanced Marsh
Maneuvres Camp was later added. This expansion drew heavily on time available from
the Louisiana Cooperative Extension Service Fisheries Agents so that the class which
they had taught six times each week during ten weeks of 4-H summer camp was
assigned to be used for environmental topics. In 1993, the class focused on ground
water. In 1994, it focused on nonpoint source water pollution and in 1995, on air
quality. Each class included 35-55 youth and was taught by 4-H agents with assistance
from adult and junior leaders. In March, 1994, an environmental issues camp was held
for teen and adult leaders. It focused on learning about the environmental issues
identified in the Louisiana Environmental Action Plan. It was supported by a U. S.
Environmental Protection Agency Region 6 Environmental Education grant and by 30
environmental specialists from the Louisiana Cooperative Extension Service, and state
and federal agencies, who came to serve as the experts on environmental issues. Two
similar camps were conducted in 1995, using the Building Common Ground
collaborative skill building workshop to help youth learn about environmental issues
and develop skills inter-personal needed in resolving the issues.
In May, 1994, a weekend environmental camp was held for sixth grade youth. It was supported by the Louisiana Department of Environmental Quality and the Louisiana Cooperative Extension Service and used hands-on experiments focusing on water and air quality, waste management, chemicals and habitat from the Science Experiences and Resources for Informal Educational Settings (SERIES) program developed by the California Extension Service. Similar camps were conducted in 1995 and 1996. (University of California, 1989)

A new camp for teens patterned after Marsh Maneuvers was conducted in the Tensas National Wildlife Refuge in 1994. It was supported by the U. S. Fish and Wildlife Service, the Tensas Resource Conservation and Development Council, the Louisiana Department of Wildlife and Fisheries, and the Louisiana Department of Environmental Quality. It was called Wild Woods Wanderings and expanded to two camps in 1995. (LSU AgCenter, 1998)

An Environmental Issue Resolution Contest was initiated in 1994 as part of the annual 4-H Short Course. Contestants selected environmental issues important to their community, wrote a paper, and gave a presentation on their findings and their proposed resolution for the issue. They were ranked based on their paper, presentation and answers to judges’ questions. Objectivity of the youth’s presentation was a primary consideration of the judges. (LSU AgCenter, 1994)

The U. S. Department of Agriculture’s Water Quality Program Plan was developed to support President Bush’s Water Quality Initiative. USDA funds were made available to support a number of water quality programs. (U. S. Department of Agriculture, 1989) The first application of these funds in Louisiana occurred in 1989.
The Tangipahoa River was posted by the Louisiana Departments of Environmental Quality and Health and Hospitals in 1988 with warnings that the fecal coliform standard for primary and secondary contact recreation had been exceeded. Dairy cattle housed in the Tangipahoa River drainage basin were considered as one source of the fecal coliform. Other sources included community and private sewage treatment plants and industrial discharges. The USDA Farm Services Agency, with assistance from the Louisiana Cooperative Extension Service, the USDA Natural Resources Conservation Service (NRCS), LDEQ and LDHH, requested Special Water Quality Project Status for Tangipahoa Parish and additional funds for cost sharing with dairy farmers on construction of improved waste management systems. This and subsequent requests for funding in the adjoining parishes of Washington and St. Helena and for Sabine Parish and DeSoto Parish in northwest Louisiana resulted in over $2,000,000 in additional cost sharing with farmers on improved waste water management facility construction. A request by the NRCS to establish a water quality program in the Big Spring Watershed in Tangipahoa Parish resulted in additional cost sharing funds for farmers in that watershed. (Louisiana Department of Environmental Quality, 1996)

The USDA Extension Service (ES) provided FY90 funds to the Louisiana Cooperative Extension Service in for enhancement of water quality programming. These funds were used for training of specialists and agents on water quality issues. The result was increased capacity and capability to deliver educational programs on water quality. (U. S. Department of Agriculture, 1989)

USDA ES made FY90 funds available for water quality enhancement programs referred to as Hydrologic Unit Areas (HUA). The Louisiana Cooperative Extension
Service together with the USDA NRCS and FSA and the LDEQ developed and submitted a proposal to USDA for an HUA targeting the reduction of sediment in rice irrigation return flows into the Bayou Queue de Tortue. It was selected as one of 37 HUA to be funded. The Louisiana Cooperative Extension Service received funding from USDA to support a water quality educational program for rice farmers in the HUA. The NRCS received funding to support increased technical assistance to rice farmers for installing water quality structures. The FSA received funding to provide cost sharing to rice farmers for implementation of water quality improvements. The LDEQ secured funds to support research on practices for improving the quality of irrigation water discharges. These coordinated programs have resulted in the use of reduced tillage on 36,170 acres of rice land in the HUA. (U. S. Department of Agriculture, 1994)

Programming Models

The Louisiana Cooperative Extension Service (LCES) has used many traditional programming models. Tyler (1949) suggested that the philosophy of the educational institution and the psychology of learning determined which teaching objectives should be pursued. The objectives were determined from studies of the learner and contemporary life. Education needs represented the gap between what is and what should be. Objectives were also determined by subject matter specialists. Learning experiences were chosen that could be accomplished by the learner, and that gave the learner practice in, and satisfaction from, the behavior implied by the objective. He said there was more than one learning experience available to obtain an objective and more than one outcome would result from the learning experience.
The Programming Handbook (LSU AgCenter, 1990) described the process of program development, evaluation and reporting to be used by the LCES. It described the mission of the LCES as helping improve lives through an educational process using research-based knowledge focused on issues and needs. It provided the basic philosophical tenets guiding extension education activities in accomplishing the LCES mission as: helping people help themselves through determination of needs and issues and participation in need- and issue-based education programs; establishing and operating an advisory system for determining needs and issues; understanding the social, cultural, economic, and technological needs of audiences; following a systematic process for planning, conducting and evaluating education programs; promoting leadership and volunteerism to help people become self-reliant; and networking with agencies, groups and organizations for efficient utilization of needed resources to plan and implement education programs.

Flint (1970) considered program development a continuous process with evaluation as an integral part of each step. He emphasized the importance of involving people who would be affected by the education program in its development. He said that advisory committees should represent all cultural backgrounds and social strata, as well as relevant groups, organizations or agencies, and should be involved in each step of program development.

According to the LCES Policy Letter No. 28 (LSU AgCenter, 1991), the major objectives of organizing and working with advisory committees were to: develop an effective education program taking into consideration the situation, needs and desires of people; give people the opportunity to express felt needs, desires, and issues for
consideration by extension in designing education programs; provide an opportunity for
lay persons to develop their leadership potential; provide an educational experience for
the people who are involved; provide for public awareness of the value of education
programs; assure extension faculty that planned programs will meet the priority needs
and issues of their clientele; and to provide a systematic procedure for keeping
extension education programs focused on existing and emerging needs and issues.

There have been a number of other programming models introduced which may
enhance environment education programming. Bennett (1992) presented an
interdependence model of extension within a public/private sector complex. He
emphasized collaboration between extension and the array of private and public sector
entities and individual and group users in order to maximize effectiveness of the
complex. Bennett said that research-transfer models of extension usually first
considered research and development outputs and then extension actions. Adult
education models usually first considered extension actions followed by research and
development outputs to the extension educational program. Bennett suggested that a
public/private sector complex interdependence model considered: the concurrent actions
and outputs of extension, research, industry and intermediate users, as well as, end users
of practices and technologies; these five elements' continuous multiple dependencies in
the generation and adoption of technologies and practices; and the education of users.
Bennett argued that the interdependence model recognized extension's: need for non-
research-based information, such as the implications of local, state and federal
ordinances, laws, rules and regulations; conduct of applied research to facilitate user
adoption of new practices and technologies; recommendations to research and
development staffs; role of education in strengthening users' abilities to make decisions and take actions. Extension had a primary responsibility for the education role in Bennett's model. He suggested that extension's strong network gave it a comparative advantage in identifying user needs, in credibility with the user, and in the ability to help research, industry and other intermediate users perform their roles. He suggested that extension widen and integrate these linkages. Bennett stated that extension should put more effort into site-specific assessment, adaptation and systemization of technologies and practices. It needed to form more coalitions with research, industry, intermediate and end users and the public in order to obtain the resources needed to better perform these roles. Bennett argued that extension is the foremost supplier of nonformal education within the public/private sector complex and that it should put more emphasis on the educational aspects of its mission. Technology transfer could be accomplished by research, industry and intermediate users. Extension technology transfer should focus on those subject and user areas where it is needed and concentrate on education of the other players and facilitating overall performance of the public/private sector complex.

Mayeske (1993) presented a life cycle program management model which began with problem finding followed by program design, development, implementation, maintenance, improvement and redirection. He suggested this model was appropriate for non-formal educational programs which emphasized experience-based learning. Mayeske considered program design as the theoretical framework which related program development and implementation to its effects and consequences. He called for program monitoring throughout the implementation, maintenance and improvement.
stages. He suggested that if a program was to be continued, monitoring would indicate any changes or redirection that might be needed. At the same time, he indicated that little planning had been done concerning ending or phasing out programs. Mayeske said that many educational programs had, or should have had, a finite life which should have been considered and accounted for in the program design. Mayeske suggested that organizational perspectives of where the organization is going in the future were important to program development and redirection and represent a constant consideration in programming. He considered a program as a dynamic theory relating activities and resources to intended results. He stated that needs should be thought of as what can be done about a problem rather than what the problem is.

Mayeske used a rigorous, facilitated workshop approach for the program design team. He suggested a program logic model which identified a set of main events which made up the program. For each main event, a set of activities and resources necessarily preceded accomplishment and a set of effects and consequences followed. Barriers and barrier-reduction methods had to be identified. As a starting point, target audiences and the desired changes in their knowledge, attitudes, skills, aspirations, and behavior must have been identified. He felt that stakeholder input was an essential ingredient of programming. (Mayeske, 1993)

**Process Skills Needed by Environmental Education Faculty**

USDA ES began a water quality initiative in 1989. One of its first products was a training needs assessment which was conducted by the Minnesota Extension Service as a series of focus group interviews of extension faculty involved with water quality programs in several states. Their conclusion was that process and strategic skills
training was needed in addition to subject matter training. Process skills were the communications, group dynamics, inter-personal and collaboration building skills needed to work with audiences. Strategic skills included the ability to scan wide-ranging sources of information in order to understand changes that audiences were going through, or would be going through, so that education programs could be developed to help the audience adapt to those changes. (Bergsrud, Casey and Krueger, 1989)

These skills were needed by all extension faculty but were especially important in all aspects of environmental education. Issues have arisen in air quality, solid and hazardous waste management, and in education for sustainability in addition to water quality. Educators should not have been expected to venture into environmental issues without having process and strategic skills training. Fortunately, there are opportunities for faculty to obtain skills training.

Risk Communication Skills

Chess and Salome (1992) surveyed 134 representatives of 137 risk communications programs in New Jersey and 128 representatives of 48 state and territorial health programs about their philosophical commitment to risk communication compared with their risk communication practices. They found much commitment but not much practice. They suggested that agencies should allocate more resources, initiate frequent risk communications with the media and the public, integrate risk communications into regular agency activities, solicit public input, train staff, and create organizational incentives to promote risk communication.

Covello and Allen (1988) listed basic rules for the U. S. Environmental Protection Agency’s risk communication brochure. They emphasized accepting and
involving the public as a partner, listening to the public, being honest, frank and open, and meeting the needs of the media.

Covello’s (1993) research indicated that caring and empathy accounted for 50% of the trust and credibility attained by a risk communicator, and that assessment of the communicator occurred in the first 30 seconds of contact. In circumstances of low trust and high concern, he said non-verbal communication could provide 50% to 75% of the message content. He reported a 1993 survey of which communicators had high levels of trust and credibility. Local citizens, non-management employees, physicians and educators were ranked in the top third. The media and environmental groups were ranked in the middle third, while industry officials, federal government officials and environmental consultants were ranked in the bottom third.

Sandman (1994) listed perceived risk characteristics of an issue which created outrage. Voluntarily assumed risks did not create outrage, whereas being coerced to accept the risk did. A natural risk is more acceptable than an industrial risk. Sandman reported the public responds more to outrage than to hazard. He provided techniques for reducing outrage in risk communication.

Cohn (1989) encouraged journalists to learn how to interpret statistics used in scientific reports so they could do a better job of informing the public. He admitted that their job required them to work quickly and to compress a story to fit within the space allowed and that it was sometimes necessary to overstate the scientific impact in order to produce a headline that attracted attention. He provided a basic understanding of statistics and research methods and suggested questions that reporters might ask medical and environmental experts and politicians in order to improve their stories.
Smith (1998) looked at the implications for environmental education of the advocacy campaign directed at Alar. He concluded that most of the media reporting on Alar was useful for informing the public. He found that sources representing the food industry accounted for 31.6% of the subsequent story citations, that government institutions accounted for 22.2% of the total, that schools (which banned apple products) accounted for 15.7% of the citations, and that advocacy groups accounted for 14.8% of the total.

Leadership Skills

The LSU AgCenter developed an Agricultural Leadership Development program for young leaders from the agricultural, forestry, or fisheries industries selected for participation in a two year program. The program was funded by private donations and by the participants with in-kind services provided by the LCES. (LSU AgCenter, 1999)

The LSU AgCenter developed a Community Leadership and Economic Development program conducted with support from the Police Jury Association of Louisiana and Cajun Electric Cooperative. The Chamber of Commerce provided assistance in selecting parish residents who participated in a series of 8-10 weekly lectures and learning activities conducted by LCES faculty, Cajun Electric, Police Jury Association staff, and consultants. Funds and in-kind services were provided by participants, the LCES, Cajun Electric, and the Police Jury Association. (LSU AgCenter, 1999)

The 4-H Youth Development program provided numerous opportunities for 4-H members to develop leadership skills through experience in club leadership positions.
participation in public speaking and community service projects, serving as junior
leaders in parish and camp events, and through special programs such as Short Course,
Challenge Camp, Marsh Maneuvers, Wild Woods Wanderings, and Environmental
Stewardship Camps. (LSU AgCenter, 1999)

Adult participants in commodity associations, parish fair boards and livestock
tables, home demonstration and Family and Community Education Clubs, and advisory
committees gained experience in inter-personal skills and group dynamics.

Collaboration Skills

Halbert and Hovey (1994) developed On Common Ground to help individuals
and groups discover similar interests and pursue mutually rewarding solutions as part of
the National 4-H Council's Environmental Stewardship Program. It evolved from
Halbert's facilitation of the National Land Use Collaboration's efforts to resolve
disagreements between competing users of public and private lands. A 16-hour
workshop, Building Common Ground, was the centerpiece of the program. It provided
training in meeting management, stakeholder identification, communication,
collaboration, negotiation, idea generation, problem definition, resource and constraint
identification and action plan development. While the skills were essential for resolving
conflicts, they also proved helpful in selecting and facilitating advisory committees and
in designing and conducting education programs.

Volunteer Training Skills

Mullen led an effort by the National 4-H Council, the USDA Extension Service,
and the Extension Committee on Organizational Policy, with funding from the W.K.
Kellogg Foundation, which resulted in a volunteer management system called Taking

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Anybody into Expanded Involvement (TAXI). It included a series of trainer's guides and workbooks which could be used as a volunteer management system training vehicle. Mullen suggested that volunteers should be both customers and partners to the organization seeking their help. As customer, involvement in organizational activities fit the lifestyle and needs of the volunteer. As partner, organizational decision making was shared with the volunteer. The TAXI program stressed eight key processes needed for a successful volunteer system: identification of people with the competence and attitudes to fill specific leadership positions; selection of individuals; orientation of volunteers to expectations for their positions; training volunteers to acquire the knowledge and skills necessary for their positions; utilization and support of volunteers in the position for which they were selected and trained; recognition of volunteers for their work; evaluation of volunteer performance and giving them feedback; and supervision of volunteers to help them obtain desired results (U. S. Department of Agriculture, 1995)

**Strategic Skills Needed by Environmental Education Faculty**

The need for strategic skills was discussed by the focus groups interviewed for the water quality training needs assessment. (Bergsrud, Casey and Krueger, 1989) Faculty must be aware of trends in natural resource consumption and availability, water quality policy, litigation, the agricultural industry, and in communications, if they are to present effective education programs.

**Natural Resources Trends**

Much of environmental education focuses on sustainability of natural resources. Dunn (1998) reported world carbon emissions rose 1.5% in 1997 compared to 1996
production. Industrial countries’ production has been relatively flat since 1970, while
developing countries have increased production by about 200% during the same time
period to a level nearly as high as the industrial countries. He reported the
Intergovernmental Panel on Climate Change projected a 65% reduction in production
would be needed to minimize the impact on climate change.

Abramovitz (1998) reported that one-fourth of the world land area, excluding
Greenland and Antarctica, was covered with forests and that loss of forest land was
primarily occurring in the tropical countries.

Mattoon (1998) reported tree plantations expanded rapidly in industrial
countries. Production increased in fast-growing plantations that could generate 25 cubic
meters per hectare in Indonesia and 30-40 cubic meters per hectare in Brazil compared
with rates of 3-5 cubic meters per hectare in Eastern Canada and 10 cubic meters per
hectare in the Southeastern United States. Northern producers accounted for about 65%
of the world’s market for pulp. There was some belief that these industrial plantations
may be able to protect the world’s remaining natural forests.

Roodman (1999) suggested cutting environmentally harmful subsidies, raising
pollution taxes and returning the savings to taxpayers as reduced income, business and
capital gains taxes. He argued that international economic organizations such as the
World Bank and the World Trade Organization would have to increasingly incorporate
environmental and sustainability concerns into their decision making. Roodman saw
reasons for optimism. He referred to results of a poll of 30 diverse nations in which
respondents from 28 of the nations felt that their governments needed to do more to
protect the environment. He discussed the increasing effect of non-governmental
organizations, including religions, on governmental and business decisions. He referred to the Toxic Release Inventory in the United States as an example of an increasing trend toward transparency, which caused businesses to voluntarily reduce their toxic discharges. Roodman suggested that environmental education was an important component of achieving sustainability but that the disciplinary divisions within education had to be overcome to increase its effectiveness.

Renner (1998) reported the world market for pollution control technology was projected to grow to $426 billion, or 2% of the world gross domestic product in 1997. Asian countries were expected to triple their share of the market, while developing countries were expected to double their share of the market.

*Water Quality Policy Trends*

Browner and Glickman (1998) presented a Clean Water Action Plan designed to accelerate progress in accomplishing clean water goals. They stated that 40% of the nation's waterways that have been assessed by states still did not meet their intended uses. Locally-led partnerships were stressed as a means of accomplishing local water quality goals. The plan listed over 100 key actions that needed to be taken to achieve water quality goals. Many of these key actions would impact farmers, rural residents and other land users. The Source Water Assessment Program under the Safe Drinking Water Act targeted pollutants that might impact drinking water derived from a surface water source. Concerns about endocrine disruption raised more questions about pesticides. Pfiesteria, harmful algal blooms and hypoxia have been related to agricultural nutrients. Coastal nonpoint source water pollution received additional attention under Section 6217 of the Coastal Act Reauthorization Amendments of 1990.
Buffer strips along surface waters were seen as a major step toward reducing nonpoint source water pollution. Agricultural marketing and promotion orders were mentioned as a means of helping farmers install and maintain best management practices. Insurance to compensate farmers for risks taken to reduce pollution and a Blue Water marketing scheme were listed as action steps. Increased support for enforceable nonpoint source authorities was discussed. On-site sewage guidelines and storm water discharges were mentioned. animal feeding operation strategies, Unified Watershed Assessments and Total Daily Maximum Loads were discussed in the Clean Water Action Plan.

Hebert (1999) argued: that many of the Clean Water Action Plan’s key actions, such as the Source Water Assessment Program, the Animal Feeding Operation strategy and the Unified Watershed Assessment program, were already underway; that the administration did not request enough money to support significant additional implementation; and that at least one lawsuit has already been filed against the Total Maximum Daily Load process. He said that the Clean Water Action Plan focused attention on clean water goals which have significant potential impacts on agriculture.

Litigation Trends

Huber (1993) reported that jurists in the United States have allowed expert witnesses who are apparently not part of the mainstream of science to testify in court on liability issues. He cited numerous instances where expert testimony, which was later proven to be wrong, helped juries make decisions resulting in harm to society in general, and to business and industry in particular. He encouraged jurists to investigate the credentials of scientists before allowing them to testify and professional associations to establish ethical codes of conduct for members who may be called on to testify.
Huber suggested that the increasing human life span accounted for much of the high incidence of cancer and that our unwillingness to accept the randomness of bad luck accounted for the temptation to accept theories which placed blame on others. He said that essential details such as dosage and timing were frequently ignored in the courtroom. Huber argued that lawyers rarely got involved in a liability case until after the scientists and engineers had established that there was a problem and after steps had been taken by agencies and industry to correct it. In that sense, the lawyers were not contributing to correcting the problem.

Agricultural Trends

The 1997 Census of Agriculture reported 1,911,859 farms in the United States which represented a decrease of 13,441 (0.7%) from the 1992 survey. The decrease would have appeared greater had not the definition changed from the 1992 Census definition, to include 75,000 small farms, 85% of which are entirely in the USDA Conservation Reserve Program or the Wetland Reserve Program. The average age of farm operators was 54.3 years compared with 53.3 years in 1992. Farm operators under the age of 35 declined to 8% of the total while operators over the age of 70 increased to 17% of the total. Female operators increased to 9% of the total, while minority farm operators increased slightly to 2.5% of the total. The number of farms with less than 50 acres and more than 1,000 acres each increased to 30% and 9% respectively. Farms with annual sales greater than $100,000 represented 18% of the total farms but accounted for 87% of the total value of farm products sold. Farms with annual sales greater than $500,000 represented about 4% of the total farms but accounted for 57% of the total value of farm products sold. Between 1992 and 1997, the average farm size declined
slightly to 487 acres, but the average value of farm products sold increased 22% to $102,970, while the average expenses per farm increased 16% to $78,771. The average value of land and buildings per farm was reported as $449,748 and of machinery and equipment as $57,678. (U. S. Department of Agriculture, 1999)

Louisiana reported 23,823 farms according to the previous definition, and 30,000 farms with the Conservation or Wetland Reserve Program and other small farms included. The average size of Louisiana farms was 331 acres and average farm sales were $85,265 while average farm production expenses were $61,532. While 11,281 farmers reported farming as their principal occupation, there were only 9,582 farms with sales greater than $10,000. Average age of farm operators was 53.7, and women accounted for 7.5% and minorities for 4.9% of Louisiana’s farmers. Of the 13 parishes with the highest farm sales, eight were in Northeast Louisiana. Seven of these parishes received most of their farm sales from row crops led by cotton, corn and soybeans, with poultry and aquaculture providing significant sales in each of two parishes. (U. S. Department of Agriculture, 1999)

The 1989 Revised County Typology considered eight non-metropolitan parishes as farming-dependent, that is farming contributed more than 20% of labor and proprietor income for the years 1987 through 1989. The eight parishes averaged 13,173 population in 1990, which was 10% less than in 1980. Per capita income in 1989 was $9,298 which was almost $1,000 less than the Louisiana non-metro parish average and more than $4,000 less than the United States non-metro county average. The poverty rate in these eight farming-dependent parishes averaged 38.1% compared to an average of 30.3% for Louisiana’s 40 non-metro parishes, and an average of 18.3% for the United

82

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
States’ 2,276 non-metro counties. Five of these eight parishes were also among the eight Northeast Louisiana parishes with the highest farm product sales and two more of the farming-dependent parishes were also located in Northeast Louisiana. All eight farming-dependent parishes were also among the 33 parishes classified as persistent poverty, that is 20% or more of the population were at or below the poverty level in 1960, 1970, 1980 and 1990. In addition, six of the eight parishes were also among the 21 parishes classified as transfers-dependent, that is federal, state and local transfer payments contributed 25% or more of total personal income for the three years 1987 through 1989. (U. S. Department of Agriculture, 1998)

Lamb (1999) predicted continuation of current trends toward increasing size of farms and more vertical integration. He pointed to an 85% decrease in the number of hog farms in the United States since 1970 along with a 16% increase in pork production during the same time frame. Economies of size was seen as the main reason for this consolidation. Lamb said that the costs of production for a 1,200-sow herd may be $30 per hundred weight compared with $50 per hundred weight for a 150-sow herd. Vertical integration also led to fewer producers.

Hassebrook (1998) argued that increased size of operations is not necessary. Research indicated that Iowa crop farms reached full economies of size at 600 acres. He argued that the economic power of large farms allowed them to receive more for their product than a small farm received and this bias needed to be corrected.

Mantemach (1999) predicted seven major trends in United States agriculture. He saw a continued trend toward large farms, citing a 46.6% increase in the number of super farms with annual sales in excess of $500,000 during the period 1992-1997, as
well as an increase in the number of hobby farms, those selling less than $10,000 per year. He saw a continued trend toward separation of ownership and operation of farms, an increased use of consultants, and of precision agricultural technologies. He saw returns to management replacing returns over variable costs, increased production of speciality crops, and more contract farming.

Blank (1998) saw continued movement of agricultural resources into uses with higher returns to investment thus reducing agricultural production in the United States, as well as in other developed countries. He reported that average returns to investment for agriculture for several decades have been 4% while the stock market has returned 13% during the same time period. He reported that the average off-farm income of farm operator households in 1991 was $32,542 compared with $3,994 of net farm income. Blank said food processors would continue to be needed to process food imported from less-developed countries. He argued that Canada may be an exception to these trends since it had vast acreages available for production agriculture and very little population and development pressure. Japan has allowed California rice to be imported and has experienced a faster decline in the number of farms than has the United States.

Environmental regulations in the Netherlands and Belgium have hastened the decline of their livestock production industry. Swiss farmers have earned income from winter skiing and tourists. Blank reported that Germany has provided financial support for their farmers to provide care for the elderly and tourism.

Blank (1998) reported increasing problems for farmers in obtaining credit as bankers moved toward less risky loans. He stated that the three largest commercial lenders to California farmers are California banks which have less than two percent
of their loan portfolios invested in agriculture. While agricultural debt in the
United States fell from $188 billion in 1983 to $139 billion in 1991, debt to firms other
than farms increased from $1.6 trillion to $3.5 trillion. Blank stated that loan
preparation fees did not vary much depending on the size of the loan so bankers
preferred to make large, well-secured loans of more than $500,000. Agricultural real
estate loans required environmental protection for the lender. Agricultural loans
generally required a risk premium.

Blank (1998) expected developed countries to import their food from less-
developed countries. He reported that Japan was importing rice from Australia and
Thailand as well as from the United States; that Argentina was ready to supply wheat,
rice and beef to China, South Korea and Japan; that Vietnam has become Asia’s second
largest exporter of rice; that India was exporting wheat, rice and coarse cereals; that
Pakistan expected to export rice; that Burma and Cambodia could be exporting rice by
2005; and that Mexico’s agricultural trade surplus was $2.4 billion in 1995. Blank
reported a 1994 study by the International Food Policy Research Institute indicating that
Russia and Eastern Europe could become food exporters in ten years if economic
reforms were successful. Blank expected much of western irrigated agriculture to
decline as urban areas and wildlife refuges competed with agriculture for water and that
this could lead to temporary support for agronomic production in areas with more
rainfall.

Harl (1998) raised questions about the increasing concentration of seed
companies. He suggested that mergers may result in fewer suppliers to farmers and that
the ability to own germ plasm as a result of the U. S. Supreme Court’s 1980 ruling on
patenting life forms may make market entry difficult for potential competitors. He said the result could be a dominant seed company contracting with farmers to produce grain for the seed company. Harl doubted that farmers would form an alliance that would give them bargaining power. He discussed the possibility of a seed company requiring farmers to purchase other inputs from them unless the Federal Trade Commission and the U.S. Justice department maintained close scrutiny over the seed company’s actions.

Harl (2000) argued that soil productivity, climate, availability of water, land and infrastructure, and the levels of farmer skills and trade barriers were factors favoring agricultural production in the United States. He said the agricultural trade surplus was a predictor of continued agricultural production and processing in the United States. Harl suggested that increased yields would continue to reduce the need for farmers and land and that increased concentration in the input supply industry and the current controversy over genetically modified organisms posed short-term problems for the industry.

Postel (1999) raised questions about the ability of irrigation and technology to sustain food production for an increasing population without significant changes in current standards of living. She reported that irrigated acreage per person peaked in 1978 and had fallen 5% since then. Low crop prices and high irrigation system costs have reduced new investment. Lending for irrigation by the World Bank, the Asian Development Bank, the U. S. Agency for International Development and the Japanese Overseas Economic Cooperation Fund peaked in the late 1970s and has dropped by nearly 50% since then. Some nations have cut their irrigation funding. Postel reported several nations were using ground water for irrigation of grain faster than the water was being recharged to the extent that about 10% of the global grain harvest was being
produced by depleting ground water supplies. Water storage reservoirs were estimated to be losing 1% of their storage capacity annually due to sedimentation. Growing urban populations were willing to pay much more for water than agriculture was paying. Industry could generate much more income from water than agriculture could. Water was needed to restore wildlife and fish habitat which placed increased pressure on water supply as recreational enthusiasts exerted more influence than farmers.

Pimentel and Pimentel (1996) raised questions about the world food supply. Using energy inputs as a basis for comparison, food production, processing, storage, transportation and consumption practices were reviewed. They suggested that increased vegetarianism in general, and increased human consumption of cereals specifically, offered the most hope for satisfying world food needs, potentially yielding 42% more protein for world population consumption. Reducing pest-induced pre-harvest and post-harvest losses of food could nearly double food availability for human consumption. Reduction of human mortality rates by use of pesticides without decreasing birth rates has caused population rates to increase significantly in many less-developed nations. Pimentel and Pimentel suggested that a world population of two billion people could probably enjoy a high quality of life. They calculated that using the United States’ agricultural technologies to provide a high protein/calorie diet for four billion people would use up the known (as of 1972) world petroleum reserves in 11 years. Pimentel and Pimentel calculated available arable land per capita at the four billion population level as 0.38 hectare. After bringing marginal land and marsh land into production, arable land per capita at the 16 billion population level would be 0.2 hectare. This assumed no loss of land to salinization, erosion and to urbanization. Water availability
for irrigation and its high cost, environmental pollution and climate change were also
discussed as significant problems. They suggested that an increased world population
required a reduction in the quality of life.

Avery and Avery (1996) predicted world population and wealth increases by the
year 2050 would require nearly three times as much agricultural output without
significant increases in agricultural land availability. They suggested that this will
require increased productivity and reduced soil erosion and degradation.

Brown and Flavin (1999) reported a United Nations estimate that world
population will increase by 4.6 billion people in the next century, mostly in less-
developed countries, and that marine fisheries and rangelands cannot be expected to
maintain current levels of food production.

McGinn (1999) reported that 6% of total protein, and 16% of animal protein
consumption came from fish. One billion people in Asia obtained 30% of their animal
protein supply from fish. Aquaculture supplied 23 million tons of the total 120 million
tons of fish consumed in 1996. The sharp increase in aquacultural supplies has
compensated for a decline in fish obtained from the oceans. Over fishing, fishing
methods, introduction of exotic species, climate change and pollution have contributed
to declines in fisheries.

Brown (1999) reported that about 841 million people were hungry and
malnourished while another 600 million were overweight. World grain consumption per
person has declined from 342 kilograms in 1984 to 319 kilograms. He reported the grain
harvest in India at 200 kilograms per person and that 64% of Indian children were
underweight. While grain-producing land is not expected to increase significantly,
double-cropping has increased production in some countries. From 1950 to 1998, the land area of harvested grain in the world fell from 0.23 hectare per person to 0.12 hectares. Brown projected that grain harvest area per person could fall to 0.08 hectares in Brazil, 0.07 hectares in India, 0.06 hectares in Bangladesh, China and Iran, 0.05 hectares in Nigeria, 0.04 hectares in Indonesia, 0.03 hectares in Ethiopia and Pakistan, and 0.02 hectares in Egypt by 2050. Brown referred to plant breeding, irrigation and fertilizers as three keys to increased land productivity during the last 50 years. Hybrid corn, dwarf wheat and rice, a three-fold increase in irrigated acreage, and a nine-fold increase in fertilizer use have been responsible for much of the increased productivity. Yields per hectare increased at an annual rate of 2.1% from 1950 to 1990 and at an annual rate of 1.1% from 1990 to 1997. Brown reported a U. S. National Intelligence Council projection that China will have to import 175 million tons of grain by 2025. Current world grain exports were 200 million tons.

Brown called for demand-side initiatives to limit population growth and increase grain and water use efficiencies. He saw education for women as a highly effective means of reducing population growth. He said grain use efficiency increase could be obtained by shifting from feeding it to cattle and hogs to feeding poultry and fish as well as shifting diets from meat to grains and vegetables. He said increasing water use efficiency required adoption of available water-conserving technologies as well as shifting diets to wheat and sorghum and away from more water-intensive rice. Brown reported carryover stocks of grain at less than 60 days of the world’s 5 million ton daily consumption even though 1997 grain harvest exceeded the 1996 record harvest. Harvest per person declined 1% to 322 kilograms which is 6% less than the 1984 high of 342

89

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
kilograms per person. Even the changes in the United States farm policy in 1990, which released 11 million hectares of idled farm land for production did not have a large effect on total grain harvested. Soybean production, on the other hand, has increased from 6.5 kilograms per person in 1950 to 26 kilograms in 1997. Meat production was at a record high of 36.1 kilograms per person and aquacultural production was at a record high level of nearly 25% of the world fish catch. A significant amount of the grain and soybean production has been used to produce the increased meat and aquacultural production. (Brown, 1999)

Communications Trends

Extension depends on communication to accomplish its mission. Its use of new communication technologies is rapidly increasing. Its audiences are adapting to these technologies at an ever increasing rate. Caimcross (1997) discussed the potential impact of the changes in the design and management of telephones, televisions, personal computers and the internet on society. Fiber-optic cables and satellites have provided a glut in telephone capacity resulting in decreasing costs of long distance telephone calls which minimized the importance of location. Wireless telephone use has speeded up the development of communications in less-developed countries and increased productivity in all countries. The use of satellites and conversion of programming from analog to digital format increased capacity for delivery of television channels. The increase in computing power and its miniaturization both decreased the cost of and increased the number of applications for computers. Networking greatly increased the productivity of multiple personal computers used within an organization. The internet not only increased the power of computers by linking them, it represented a major expansion of...
communications capabilities and capacities, as well as an opening up of unexpected opportunities for commerce. Cairncross suggested that since all three appliances can handle digital data, their interconnections were greatly simplified. She said the potential for combining features of wireless telephones, televisions, personal computers and the internet offered tremendous opportunities for improvements in commerce and society.

Cairncross saw these improvements in communications as helping business improve its efficiency, lower its costs and improve its response to customer needs. She reported that the knowledge embedded in a good or service is accounting for an increasing share of the value of the good or service. While improved information access will benefit the customer, she expected there to be a need for an intermediary to interpret the information and increase its usefulness. Cairncross expected that improved communications would allow employees to work together as teams of independent workers from distant sites and would increase democracy in the workplace. Skills such as articulation, courtesy, creativity, accuracy and resourcefulness would be more important in the workplace. Lack of skills would be penalized even more than at present. She expected distance education to become very important as a cost-cutting tool. Cairncross reported that the Central China Television University had over a million students. (Cairncross, 1997)

O’Meara (1998) reported that 133 satellites were launched by more than a dozen countries in 1997. Most of these launches supported communications needs. As many as 1,700 communications satellites were expected to be launched in the next decade. She reported the number of lines for telephones continued to increase at about a 7% annual rate to 740 million in 1996. Cellular mobile telephones, however, have increased by an
annual rate of 52% since 1991, to a total of 135 million in 1996. In Cambodia, 60% of telephone subscribers used mobile cellular phones.

These trends need to be evaluated by environmental education programmers in designing curricula for their audiences to prepare them for a changing environment. Additional insight into programming needs can be gained by reviewing the work of futurists. Hicks (1996) discussed the methods used by futurists and the need for environmental educators to adopt these techniques.
SUMMARY OF REVIEW OF LITERATURE BY OBJECTIVE

Objective 1

Describe Environmental Education in the United States

The roots of environmental education in the United States have been traced to nature study in 1891, conservation of natural resources in 1935, and outdoor education in the mid-1900s. National and state legislation supporting environmental education began to appear in the early 1970s. International conferences supported by the United Nations helped give additional visibility and definition. (Braus and Disinger, 1998) The North American Association for Environmental Education (1998) was organized by K-12th grade teachers, college and university faculty and non-formal educators. It published a bi-monthly magazine, a quarterly Journal of Environmental Education and other resource materials useful to environmental educators and conducts annual conferences. An international refereed Journal of Environmental Education Research was published three times each year.

Several federal agencies such as the U. S. Department of Agriculture (1981, 1995, 1996a,b,c), the U. S. Environmental Protection Agency (1994), the U. S. Department of the Interior (1996, 1998), and the National Aeronautics and Space Administration (1997) have developed training materials to enhance environmental and science literacy. Many non-governmental organizations such as the League of Women Voters (1994), the Lake Pontchartrain Basin Foundation (Banbury and Rheams, 1997), the National Association of Conservation Districts (Duckworth, 1998), and the National 4-H Council (1994, 1995a,b,c) have sponsored national environmental programs and workshops and have developed and distributed environmental education materials.
The American Forest Foundation (1996), the Western Association of Fish and Wildlife Agencies, the Western Regional Environmental Education Council (1992), and the Watercourse developed and implemented non-formal education programs such as Project Learning Tree, Project Wild (Charles, 1992), and Project WET. (Durney, 1995) The Can Manufacturer’s Institute (1997) developed educational materials on recycling. Agricultural commodity associations such as the National Pork Producers Council (1996) have developed guidelines for pork producers to reduce odor complaints.

National surveys of environmental literacy indicated what the general public thought were important environmental issues. The National Environmental Education and Training Foundation (1994) survey of youth indicated destruction of the ozone layer and the rain forest as their highest concerns. The National Geographic Society (1993) reported fresh water pollution was among the concerns of youth and adults. Warren (1994) reported youth ranked protecting the environment as the biggest problem but their parents ranked it as the sixth biggest problem. The Better Homes and Gardens survey of adults reported water pollution as the worst environmental problem, with deforestation, air pollution and smog, ozone layer depletion and nuclear wastes selected as less serious problems. (Cooper, 1994)

The American Water Works Association’s survey of adult attitudes toward their drinking water found that 63% thought their drinking water was good or excellent and 75% believed their drinking water quality met or exceeded federal standards. Of the 1,603 respondents, 56% reported drinking tap water all of the time and 8% reported drinking bottled water all of the time. (Galbraight, 1994) The Water Quality Association reported that 20% of their survey respondents were dissatisfied with the quality of their
household water supply and that 1/3 used some type of home water treatment device. (Censky, 1997) The Colorado Pollution Prevention Partnership (1994) survey found that 2/3 of the business respondents used chemical substitutes to prevent pollution and that input suppliers were their primary source of information. The Dealer Progress survey of agri-chemical dealers about spill containment systems found that 96% of respondents reported using them around their pesticide bulk storage tanks and 67% reported using them around their bulk fertilizer storage tanks. (Nowells, 1994)

The Sandoz Agro, Inc. (1993) survey asked farmers for the most serious environmental problems associated with agriculture found contamination of surface and ground water by pesticides and fertilizers as most important. A survey of Utah farmer’s attitudes toward sustainability, found 86% using long-term crop rotations, 56% using cover crops, 41% using fallowing and 40% using minimum tillage. (Drost, Long, Wilson, Miller and Campbell, 1996) A survey of Iowa farmers interested in sustainability found that the more they relied on conventional sources of information, the more they used chemical inputs. (Petrzelka, Korsching and Mailia, 1996)

The comparative risk survey by 75 U. S. Environmental Protection Agency staff (1987 a,b,c,d,e) found indoor radon and indoor air pollution, stratospheric ozone depletion, global warming, and nonpoint source water pollution among areas of relatively high risk but low corrective or preventive effort. Areas of high effort but relatively medium or low risk included Superfund sites, underground storage tanks, and industrial and municipal solid waste sites. A similar study conducted by Region 6 of the United States Environmental Protection Agency (1990 a,b,c) found conversion of terrestrial ecosystems to agriculture and forestry as the highest risk to the ecology.
Issues surveys by state extension services have found the environment an important issue for inclusion in their educational programs. Clemson identified 20 program areas, several of which included aspects of environmental education. (Webb, 1987) Vermont’s survey resulted in seven issues one of which was improving environmental quality. (Honnold, 1988) Nebraska respondents listed environmental issues behind economic and sociological issues in counties and behind the economy in the state and nation. (Florell, 1990) Enhancing water quality and conserving and managing natural resources were two of the seven initiatives established by Nebraska. (Bolen, 1990) Texas respondents identified 2,700 separate county issues. Two of the six state issues were water quality and conservation, and environment and natural resources. Five of the 23 state initiatives were also environmental (Carpenter, 1989)

The U. S. Environmental Protection Agency (1994) reported agricultural runoff as the most extensive source of pollution for the assessed water bodies which did not meet clean water goals. Nutrients, silt, organic matter, pathogen indicators, pesticides and suspended solids were the leading pollutants from agriculture.

U. S. Department of Agriculture (1996b) research indicated that crop productivity is three times what it was in 1935. One implication was that we could produce the same amount of product from less land than was used in 1935, which might expose less crop land to soil erosion. Water quality programs have documented significant increases in adoption of nutrient, pesticide, animal waste and irrigation water best management practices as well as conservation cropping and tillage and cover and green manure crop practices. Two of the most significant outcomes of early work on reducing nonpoint source water pollution were the realization of the importance of
documenting changes in water quality as a result of implementing best management practices and the difficulty in doing so. Much work has been done with computer models and they will continue to be important. Documenting change in watershed runoff, however, required establishing baseline conditions under several years of varying weather conditions in similar watersheds before installing the treatments in one of the watersheds. This was then followed by years of monitoring runoff under varying weather conditions in both treated watershed and control watershed. (U. S. Department of Agriculture, 1996d)

Sustainability has received increasing attention as a concept. Pimentel and Pimentel (1996) suggested that the earth can carry two billion people at a high level of quality of life. The National Science and Technology Council (1994) encouraged a shift to pollution prevention from waste management. They included education and training and information dissemination as two of ten key policy areas. They included K-12th grade and post-secondary students and the general public as key audiences. They suggested cost-benefit and life cycle analysis, risk assessment, and ecological evaluation as tools to help in the understanding of environmental and economic relationships. They reported the need for improved agricultural technologies to reduce soil erosion, greenhouse gas emissions and the use of chemical-based pest and nutrient inputs, as well as improved forest regeneration, wildlife habitat and biomass production practices.

The National Science and Technology Council (1995) issued a National Environmental Technology Strategy which included five themes. One of the five themes was called Learning and Working Together which involved collaborative approaches to infusing environmental education into all grade levels. They reported current
departmental segregation along subject matter lines as a barrier to the inter-disciplinary efforts needed to develop and implement sustainable strategies. The President’s Council on Sustainable Development (1996a) sponsored a forum which focused on six themes including lifelong learning, interdisciplinary approaches, systems thinking, partnerships, multi-cultural perspectives, and empowerment. One of its recommendations was the establishment of an extension network patterned after the cooperative extension program, the Sea Grant College Program, the Space Grant College Program and the manufacturing extension services.

Robert’s (1997) The Natural Step looked at the earth as a system using basic laws of thermodynamics as guiding principles. He related holistic viewing of the earth to the systems thinking concepts espoused by many management philosophers.

The U. S. Department of Agriculture (1997a) reported that from 1945 to 1992, for the 48 conterminous states, the land area in grassland, pasture and range decreased from 45% to 31%, land area used for forests decreased from 32% to 30%, and cropland used for production decreased from 19% to 18%. From 1945 to 1992, land area used for parks and wilderness and recreation areas increased from 1% to 4.6% and land used for urban purposes increased from 1% to 3% of the total land area. They reported agricultural involvement in over half of the threatened or endangered plants and animals, in 81% of the loss of wetlands from 1954 to 1974 and 20% of the loss of wetlands between 1982 and 1992. They estimated that agricultural runoff accounted for 60% of the sediment and about half of the nitrogen and phosphorus reaching surface waters in 1993. Agricultural production and processing accounted for about 75% of total usage of pesticides in the United States. Total direct energy consumption, other
than electricity, by agriculture in the United States decreased by 25% from 1978 to 1993 while agricultural output increased 47%. Conservation tillage was used on 35% of crop land planted acres in 1996.

From a national perspective, environmental education in the K-12th grades continued to grow with support from federal, state and local agencies, business and industry and non-governmental organizations. Environmental education has become a component of many undergraduate and graduate degree programs. Public agencies and business and industry have hired staff trained in environmental and natural resource sciences and provide them with additional training on the job.

Extension surveys of public issues found high levels of concern about environmental issues. Other surveys indicated public support for highly publicized environmental concerns. This support has, in some cases, resulted in the appropriation of public and private funds to reduce and/or remediate the impact of these popular environmental concerns while other less-publicized environmental problems with greater human health consequences are relatively unfunded.

Objective 2

Describe environmental education in Louisiana.

Louisiana's Legislature passed environmental education legislation in 1993 and in 1995. (Louisiana Environmental Education Act, 1993, 1995) The legislation resulted in a Governor's Environmental Education Commission, an Office of Environmental Education, and a Director. A license plate was approved to raise money for grants to environmental educators. Environmental education had been conducted by K-12th grade teachers and supported by federal and state agencies for many years prior to the
legislation. Notable support for K-12th grade teachers has come from the Louisiana Department of Agriculture and Forestry (1996) and the forest industry sponsorship of Project Learning Tree. Faculty in colleges of education have teamed with forestry professionals to ensure that the latest pedagogy is infused into the training of teachers and trainers on the use of lesson plans and activities. The Department has more recently assumed responsibility for conducting Project WET (Water Education of Teachers). The Louisiana Department of Wildlife and Fisheries has done an outstanding job of supporting environmental educator training through its sponsoring of Project Wild, Project Aquatic Wild, and numerous camps at its Grand Terre laboratory and its Environmental Education Center. Many of their educators have been involved with hunter education and fishing clinics. (Louisiana Department of Wildlife and Fisheries, 2000) Louisiana’s environmental educators have held annual symposiums since 1996. (Governor’s Office of Environmental Education, 1999)

The Louisiana Department of Environmental Quality (1991) led the conduct of a comparative risk project in 1990. The Louisiana Environmental Action Plan included input and concerns from the public which was not the case in the federal and regional comparative risk surveys which had been completed.

The Environmental Education Commission sponsored a survey to evaluate environmental education programs and environmental literacy in Louisiana. The environmental topics developed by the Louisiana Environmental Action Plan were used as the basis for the topics in the survey. Survey results indicate environmental education opportunities varied widely by parish: High school, middle school and Louisiana State University students did not rate their environmental education very highly. Programs
were not rated highly in terms of preparing students or the public to deal with issues nor to change behaviors or attitudes. (Hair, 1994)

The Louisiana Cooperative Extension Service conducted an Issues Advisory Committee survey in 1989 to determine programming needs of its clientele. Each parish made a concerted effort to invite non-traditional clientele to parish meetings. Results were summarized into four main areas, one of which was environmental concerns. (Baker, 1992) This process was repeated in 1999 through the use of a parish Open Forum in which invited guests were asked to develop issues of concern to their community and then rank them in terms of importance and probability of success in the next 3-5 years. The top four issues were then developed in a parish Futures Forum where goals and objectives, and action plans were established. Economic development and education were the top issues in most of the 63 parish open forums. Environmental issues were not listed as frequently as they were in the 1989 Issues Advisory Committee process. (LSU AgCenter, 2000)

Louisiana Cooperative Extension Service environmental education programming has expanded for all audiences. A major multi-agency and industry effort has been conducted since 1990 to acquaint farmers with the best management practices which can help reduce soil erosion and loss of agricultural chemicals from farm fields. The Louisiana Farm Bureau Federation has taken a strong leadership role in encouraging adoption of these practices by farmers. (LSU AgCenter, 1996) The Louisiana Forestry Association (1988, 2000) has provided leadership for implementation of best management practices by loggers and forest land owners. (LSU AgCenter, 2000) Environmental education in Louisiana has progressed as it has in the United States.
There has been a long history of agencies, business and industry and non-governmental organizations working together on environmental issues in Louisiana. The traditional interest in hunting and fishing and other outdoor skills, and the climate and the cultural history of Louisiana have supported an environmental ethic.

Objective 3

Describe components of existing extension education programming models which would improve the effectiveness of environmental education programming by the Louisiana Cooperative Extension Service

Traditional extension programming models are appropriate for use in environmental education programming. Models presented by Bennett (1992) and Mayeske (1993) are especially pertinent. Some programming model components and both subject matter and skills training need to be emphasized.

Tyler (1949) stated that educational needs represent the gap between what is and what should be. The comparative risk surveys indicated the gap between environmental risk as understood by environmental professionals and environmental concerns of the general public. (Environmental Protection Agency, 1987 a,b,c,d,e)

The LSU AgCenter indicated that promoting leadership and volunteerism to help people become self-reliant was one of the basic philosophic tenets guiding extension educational activities and that organizing and/or working with advisory groups was one of the steps in program planning. Extension policy stated that three major objectives of organizing and working with advisory committees were to provide an opportunity for lay persons to develop their leadership potential, to provide an educational experience for people who are involved, and to provide a systematic procedure for keeping extension educational programs focused on existing and
emerging needs and issues. (LSU AgCenter, 1990, 1991) Advisory groups of citizens provided extension with their environmental concerns while advisory groups of extension professionals provided extension with environmental practice and regulatory impact not generally available from the research community. Advisory committees provided an opportunity for extension to educate select groups of individuals and to provide them with the process and strategic skills which helped them play an effective role in their community’s environmental programs. Advisory groups have served to leverage extension educational resources.

Another basic tenet listed by the LSU AgCenter (1990) was networking with agencies, groups and organizations for efficient utilization of needed resources to plan and implement educational programs. Environmental education included information which is not part of the research which extension normally relies on. This made it necessary to involve environmental agencies and non-governmental organizations in extension advisory committees because of their expertise and knowledge.

Flint (1970) considered program development as a continuous process with evaluation as an integral part of each step. Flint said the Louisiana Extension Management Information System could make a worthy contribution to the program development process provided it was considered as a management system rather than just a reporting system. Both federal and state governments have increased their demands for accountability. The contract work that the Louisiana Cooperative Extension Service has depended on for funding of environmental programs called for intensive accounting of resource use toward goal accomplishment. Increased accountability has continued to apply to educational programs.
Bennett (1992) described his interdependence model emphasizing collaboration between extension, research, and an array of public and private sector intermediate and end users. It recognized extension’s need for non-research based information, for conduct of applied research, and for strengthening user’s abilities to make decisions and take actions. Bennett stated that research, industry and intermediate users can conduct technology transfer and that extension should focus on its educational role.

Mayeske (1993) presented his life-cycle program management model including a continuous monitoring function to indicate need to make changes. He said education programs should have been designed with a finite life and a mechanism included to transfer extension’s role to another person or organization. Mayeske used a facilitated workshop approach to program design called evaluability assessment. (Verma, 1990a)

The focus groups facilitated by Minnesota extension faculty determined training needs for extension water quality programming. Subject matter training was the first priority but training in process and strategic skills was also considered very important. Subject matter training was considered critical because water quality science was not part of the academic preparation for most extension faculty. Process and strategic skills training was considered important because of the controversial and rapidly changing nature of many water quality issues. (Bergsrud, Casey, Krueger, 1989) The issues focus groups facilitated by Baker (1992) said extension faculty needed training in team building, facilitation, group dynamics, and in selecting and working with volunteers. Environmental education faculty could be expected to have similar needs for training.

Leadership skills development programs have been conducted by extension for adult audiences, and by 4-H agents for youth audiences. (LSU AgCenter, 1999) A
collaboration skills training workshop was developed by the National 4-H Council and has been provided to extension administrators. (Halbert and Hovey, 1994) Mullen participated in the development of volunteer management training programs which have been used in Louisiana. (U. S. Department of Agriculture, 1995)

Strategic skills training has not been conducted for faculty. Each discipline has access to sources of information which can be used to identify current trends and estimate future directions. These skills are essential to successful programming.

**Objective 4**

Determine subject matter content perceived by agricultural and natural resource agency professionals as appropriate for delivery in an environmental education program for farmers in Louisiana

References to environmental education subject matter content appropriate for delivery to Louisiana’s farmers and appropriate priorities for presenting that material were not obvious from the review of literature. Many surveys pointed out the gaps between environmental knowledge of groups of respondents and current scientific understanding. Several surveys pointed out concerns of farmers and rural residents in regard to sustainability and environmental issues.

A traditional extension program development concept has included the use of advisory committees of stakeholders who expressed their needs for education. The literature review indicated divergence between public perception of environmental risks and science’s understanding of environmental risk. Environmental education subject matter guidance has been considered more useful if received from professionals with responsibility for working in one or more environmental media affecting farmers.
Advisory committees of agency professionals have supported environmental education for various Louisiana farmer audiences. The Louisiana Cooperative Extension Service has worked with experienced professionals in state and federal agencies on environmental topics. Agency professionals have been aware of the capabilities of the Louisiana Cooperative Extension Service in providing science-based information to farmers and rural communities through this collaborative efforts. Agency professionals have exhibited knowledge about current and future environmental issues. They have been responsible for enforcing new and existing environmental laws and regulations or for providing technical, financial and research assistance to farmers adopting cultural practices which will enhance environmental quality.

Agency professionals have been involved in managing environmental issues on a daily basis in all parts of the state. Participation in a traditional advisory committee would have taken them away from their jobs and required them to travel to a central location for one or more meetings. A more resource-efficient technique for obtaining expert opinion from agency professionals is the Delphi Method as described in Delbecq, van de Ven, and Gustafson (1975), Linstone and Turoff (1975), Scheele (1975), and Scheibe, Skutsch and Schofer (1975).

While no one agency representative could be expected to be knowledgeable about every environmental issue, those with lengthy experience in their work possessed expertise in one or more environmental media and were familiar with other environmental media because of their extensive association with other environmental professionals. These professionals were reasonably objective in their views and pragmatic in their expectations about farmer adoption of best management practices to
enhance the environment. At the same time, it was recognized that agency professionals pursued the goals and objectives of their agencies and that their responses were probably influenced by their agency perspective. Representatives from agricultural agencies might have been expected to view environmental issues differently than panelists from non-agricultural agencies. Senior agency staff might have been expected to view issues differently than junior agency staff. Staff with expertise in one media, such as air quality, could have considered issues in that media more important than issues in another media, such as solid waste. Staff may have been uncomfortable at being asked to rate issues in a media for which they did not have direct agency responsibility. Using a Delphi panel with a minimum of 30 representatives of a variety of agencies minimized the effect of these biases on the panel’s collective results.
Panelists

Agencies were selected for representation on the Delphi panel based on their experience and responsibility for environmental issues facing Louisiana farmers. The U.S. Department of Agriculture and the Louisiana Department of Agriculture and Forestry play important roles in agricultural environmental issues. Environmental regulations pertinent to farmers are enforced by the Louisiana Departments of Natural Resources, Wildlife and Fisheries, Health and Hospitals, and Environmental Quality.

The panel included representatives of the USDA Natural Resources Conservation Service, Farm Services Agency, and Agricultural Research Service. The Natural Resources Conservation Service provided technical assistance to farmers in reducing environmental problems associated with soil erosion, runoff, or leaching of agricultural chemicals, reduction of animal waste problems, degradation of wildlife habitat, and restoration of wetlands. The Farm Service Agency provided financial assistance to farmers for adoption of best management practices designed by the Natural Resources Conservation Service. The Agricultural Research Service conducted research to support the recommendation of best management practices. These three USDA agencies had responsibilities for providing technical or financial assistance to farmers or for conducting research. They did not enforce regulations.

The Louisiana Department of Agriculture and Forestry had expertise in forestry, livestock, poultry, horticultural and row crop environmental issues. The State Veterinarian was responsible for regulations related to animal health as well as management of animal waste and mortalities. The Office of Soil and Water
Conservation provided technical support to farmers in designing and installing best management practices. The Office of Environmental Sciences enforced pesticide regulations and responded to pesticide drift complaints and emergencies such as pesticide spills. The department had responsibility for prescribed burning in forestry and agriculture. Department staff provided technical or financial assistance to farmers, conducted inspections and tests, issued permits and licenses and enforced regulations. Some staff were involved in education programs.

The Louisiana Department of Natural Resources was responsible for implementation of the Coastal Zone Act Reauthorization Amendments of 1990 which required a coastal zone nonpoint source water quality program targeting farmers and foresters as two of five primary audiences. This program included authorization for enforcement.

The Louisiana Department of Wildlife and Fisheries was responsible for the Scenic Streams program, for marine fisheries, and for wildlife and fisheries habitat issues which caused it to frequently become involved with farmers and other land owners. Some staff enforced regulations. A number of staff were involved in conducting education programs.

The Louisiana Department of Health and Hospitals was responsible for safe drinking water programs for public water supplies, individual household sewage systems, and for dairy parlor, slaughter house and food processing plant sanitation inspection. The department shared responsibility with the Department of Agriculture and Forestry on some pesticide issues, with the Department of Wildlife and Fisheries on some marine fisheries environmental issues, and with the Department of Environmental
Quality in some surface water quality issues. Staff enforced regulations and have frequently conducted education programs.

The Louisiana Department of Environmental Quality was the primary state agency dealing with the regulation of air and water quality, radiation safety, and solid and hazardous waste. Field staff have investigated complaints about odors, waste water, or nonpoint source discharges, or solid waste management practices associated with livestock, poultry, aquacultural, horticultural, agronomic and silvicultural production, and processing. Staff have administered programs for the U. S. Environmental Protection Agency and have conducted education programs.

The panel of experts were comprised of representatives from these agencies: who had nine or more years of experience, who had been involved in issues related to agriculture, and who had worked with the Louisiana Cooperative Extension Service. The Louisiana Department of Environmental Quality which had the regulatory authority of most interest to farmers and the Natural Resources Conservation Service which provided resource management technical assistance to farmers accounted for 26 of the 41 panelists. Panelists’ years of experience was used as an indicator of expertise. Panelist responses were used as an indicator of the effort they expended on the instrument. Agency response was used as an indicator of agency bias. The effect of seniority of panelists on ratings was determined.

Instrument

The researcher developed an initial list of 55 environmental education topics with which the Louisiana Cooperative Extension Service had been involved in recent years. Topics included air and water quality, and solid waste issues, best management
practices, and issues related to rural life including concepts such as sustainability and bio-diversity. As indicated in Table 1, the topics were arranged into categories including drinking water, nonpoint source, point source, ground water, air, solid waste, and multi-media to try and help panelists understand the issues associated with each topic. The instrument and cover letter to panelists are included as Appendix A. An explanation of these topics is included as Appendix B.

Table 1 Number of Delphi round 1 instrument topics listed in each environmental category

<table>
<thead>
<tr>
<th>Number of Topics</th>
<th>Environmental Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>drinking water</td>
</tr>
<tr>
<td>9</td>
<td>nonpoint source</td>
</tr>
<tr>
<td>4</td>
<td>point source</td>
</tr>
<tr>
<td>6</td>
<td>ground water</td>
</tr>
<tr>
<td>13</td>
<td>air quality</td>
</tr>
<tr>
<td>10</td>
<td>solid waste</td>
</tr>
<tr>
<td>11</td>
<td>multi-media</td>
</tr>
</tbody>
</table>

The initial list served as the first iteration of environmental topics in the Delphi process. This reduced the time required of the panelists and helped them to understand what was expected of them, and to focus their suggestions for additional topics. The instrument was presented independently to each panelist as Round 1. The panelists were asked to rate the topics using a seven point scale. A rating of one represented the panelist’s estimation of a topic of lowest importance and a rating of seven represented
the panelist’s estimation of a topic of highest importance for inclusion in an extension environmental education program directed at farmers. Panelists were invited to add additional topics they felt appropriate.

The mean of the panel’s ratings of each topic in Round 1 was reported back to each panelist, along with their individual rating of each topic, for Round 2. New topics added by panelists during Round 1 were included in the instrument mailed to the panelists for Round 2. Each panelist was given the opportunity to change their Round 1 rating and was asked to rate the new topics added by panelists in Round 1. The mean of the Round 2 topic ratings was calculated and the topics were arranged in descending order from highest to lowest mean rating. The averages of the topic ratings were compared by farm commodity, by environmental topic category, by agricultural and non-agricultural agency, and by senior staff and junior staff.
Career status of potential Delphi panelists was reported as an indication of equivalence of respondents and non-respondents. Experience of respondents by agency was reported as an indicator of the level and quality of expertise of panelists representing agencies. Panelists’ responses to the Round 1 and Round 2 instruments, and topics added in Round 1 were reported as an indication of panelists’ interest in and support of the Delphi process. The changes made by panelists in their Round 1 ratings were evaluated in terms of the number of panelists making changes, the direction of changes made, and the potential impact of panelist rating changes on final ratings.

Responses of Potential Delphi Panelists

Of the 56 potential panelists, 41 (73%) responded to the Round 1 mailing of topics during the months of July and August, 1999. Panelists were asked to report their years of experience which were grouped into three categories of career status. Those with more than 25 years of experience were placed into a “senior-career” category. Those with 16 to 25 years of experience were placed into a “mid-career” category, and those with less than 16 years of experience were placed into an “early-career” category.

Nine of the 15 non-respondents were estimated by the researcher to be senior-career, five to be mid-career, and one to be an early-career agency staff as shown in Table 2 and Figure 1. The agencies and/or areas of expertise of these non-responding potential panelists were represented by responding panelists. Early-career staff responded at a higher rate (91%) than did mid-career staff (77%) or senior-career staff (61%). Since this response was larger than the intended panel size of 30 panelists, and since the respondents’ level of expertise was high, no second effort was made to contact
non-respondents. The potential effect of the non-respondents on the results of the Delphi process was judged by the researcher to be minimal.

Table 2 Number of respondents and non-respondents who were estimated to be in senior-career, mid-career, or early-career status in their agencies

<table>
<thead>
<tr>
<th>Senior-career</th>
<th>Mid-career</th>
<th>Early-career</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resp</td>
<td>Non-R</td>
<td>Resp</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>17</td>
</tr>
</tbody>
</table>

Figure 1 Number of respondents and non-respondents by career status

Characteristics of Panelists

Table 3 includes panelists’ reported years of experience by agency, within the senior-career, mid-career, and early career categories defined above. The means of years of experience reported by staff representing the Louisiana Departments of Wildlife and Fisheries, and Health and Hospitals were higher than the means of years of experience.
reported by the other agencies. Six of the seven representatives of these two agencies were included in the senior-career category. Analysis of variance indicated those two departmental means were significantly different ($p = 0.05$) from the other departmental means. Figure 2 shows the range of reported years of experience of panelists by agency.

Table 3 Number of Delphi panelists reporting years of experience by agency

<table>
<thead>
<tr>
<th>Agency</th>
<th>Years of Experience Reported by Panelists</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26 or more</td>
<td>16 to 25</td>
<td>15 or less</td>
<td>Max</td>
<td>Min</td>
<td>Mean</td>
</tr>
<tr>
<td>USDA</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>28</td>
<td>10</td>
<td>22.4</td>
</tr>
<tr>
<td>LDAF</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>35</td>
<td>10</td>
<td>17.6</td>
</tr>
<tr>
<td>LDNR</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>25</td>
<td>15</td>
<td>21.0</td>
</tr>
<tr>
<td>LDWF</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>32</td>
<td>26</td>
<td>29.0</td>
</tr>
<tr>
<td>LDHH</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>32</td>
<td>19</td>
<td>28.2</td>
</tr>
<tr>
<td>LDEQ</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>29</td>
<td>9</td>
<td>19.5</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>17</td>
<td>10</td>
<td>35</td>
<td>9</td>
<td>22.9</td>
</tr>
</tbody>
</table>

Thirteen panelists were employees of the United States Department of Agriculture (USDA). Of these panelists, eleven were employed by the Natural Resources Conservation Service including three state program administrators, two regional administrators, three state program specialists, two regional specialists, and one multi-parish administrator. Each of these panelists was responsible for technical assistance to farmers on environmental issues. One panelist was employed by the Farm Services Agency in the role of administering financial assistance programs to farmers.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
for installation of environmental protection practices. He had previously served in a multi-parish position before assuming state responsibilities. One panelist was a researcher on agricultural water quality issues with the Agricultural Research Service.

![Figure 2 Range of years of experience reported by Delphi panelists by agency](image)

Five panelists were employed by the Louisiana Department of Agriculture and Forestry (LDAF). One was responsible for livestock and poultry health, processing plant design and inspection, and mortality management issues. Two were responsible for pesticide issues including licensing, enforcement, drift complaints, and emergency response. One was responsible for soil and water conservation programs and one for horticultural programs. One panelist was previously employed by the Louisiana Cooperative Extension Service. Each of the panelists worked in the field with farmers on a regular basis.
Three of the panelists were employed by the Louisiana Department of Natural Resources (LDNR). They were responsible for coastal nonpoint source water quality programs including agriculture and forestry as two of the five targeted audiences.

Two of the panelists were employed by the Louisiana Department of Wildlife and Fisheries (LDWF). They were responsible for educational and regulatory programs. One panelist was previously employed by the Louisiana Cooperative Extension Service.

Five of the panelists were employed by the Louisiana Department of Health and Hospitals (LDHH). One served as a state administrator for environmental programs. Two had served as the environmental consultant to the Secretary of LDHH, one as head of the drinking water programs, and two as regional specialists with responsibilities for drinking water, sewage and septage management, and agricultural product processing environmental issues. One had been an employee of the United States Environmental Protection Agency. Each was actively involved with issues in the field.

Thirteen of the panelists were employed by the Louisiana Department of Environmental Quality (LDEQ). Seven had worked primarily on water quality issues. Three had worked with ground water programs, one with non point source water quality programs, and four were involved in the Tangipahoa River dairy farm waste water issue. Two panelists were involved in administration and technical analysis of solid and hazardous waste programs which included farm and farm product processing waste management. Three panelists were involved in air quality issues which included agricultural burning, dust and odors. One panelist had been appointed to a national agricultural air quality work group. One panelist served as the environmental education representative for LDEQ and had been responsible for the Louisiana Environmental...
Action Plan to 2000 comparative risk program conducted by LDEQ. One panelist’s father had retired from the Louisiana Cooperative Extension Service.

The intent of the panelist selection process was to secure participation by agency representatives with experience in environmental issues related to agriculture. While no two panelists had exactly the same experience, their combined experiences covered most of the environmental issues related to agriculture. Of the 41 panelists, 18 (44%) were employed by federal or state agricultural agencies and 23 (56%) were employed by state agencies with regulatory responsibilities in environmental areas directly affecting agriculture and/or rural residents. The mean years of experience as reported by panelists indicated awareness of both the national and the Louisiana historical records of environmental issues, the current and probable future directions of those issues and the probable impacts on agriculture and rural residents of those environmental issues.

Panelists’ Responses to Delphi Round 1

If all 41 panelists had rated all 55 topics there would have been a total of 2,255 topic ratings (41 x 55 = 2,255). As indicated in Table 4, 18 topics (33%) were rated by all 41 panelists. In addition, 16 topics (29%) were rated by 40 panelists, 18 topics (33%) by 39 panelists and 3 topics (5%) by 38 panelists, or each topic received at least 38 ratings. This provided a total of 2,194 topic ratings or 97% of the maximum possible number of topic ratings. This indicates a broadly-based evaluation of each topic.

Of the 41 panelists, 32 (78%) rated all 55 topics, five (12%) rated 54 topics, two (5%) rated 53 topics, one each rated 32 topics and 26 topics (5%) as indicated in Table 5. The panelist rating 32 topics failed to complete the second page of the instrument. The panelist rating 26 topics did not rate any topic which was not specifically in his
field of expertise. These two panelists accounted for 52 (85%) of the 61 non-ratings. At least 39 (95%) of the 41 panelists rated 53 (96%) or more of the 55 topics. This effort by the panelists indicated a high level of interest and a willingness to take the time to complete and return the instrument.

Table 4: Number of Delphi round 1 topics rated by number of panelists

<table>
<thead>
<tr>
<th>Number of Round 1 Topics Rated</th>
<th>Number of Panelists Rating Each Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>41</td>
</tr>
<tr>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>18</td>
<td>39</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
</tr>
</tbody>
</table>

Table 5: Number of panelists rating number of Delphi round 1 topics

<table>
<thead>
<tr>
<th>Number of Panelists</th>
<th>Number of Topics Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>54</td>
</tr>
<tr>
<td>2</td>
<td>53</td>
</tr>
<tr>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>26</td>
</tr>
</tbody>
</table>

In addition to rating the environmental topics included in the Round 1 instrument, ten of the 41 panelists provided a total of 25 additional topics. These topics ranged from very specific and localized problems such as dog kennels, to very general and global problems such as population control, and included a number of best practices.
management practices for reducing the impact of environmental problems and for increasing sustainability. The additional topics were classified into the environmental categories of 1) nonpoint source water quality, 2) solid waste, and 3) multi-media as indicated by Table 6. Almost all of the panelists worked with nonpoint source water quality issues and recognized the importance of nonpoint source water quality topics for inclusion in an education program directed at farmers. That category accounted for 13 (52%) of the 25 added topics. Three of the panelists provided either one or four additional topics and two of the panelists provided either two or three additional topics as indicated in Table 7. Appendix C provides a list of the topics added and the researcher’s estimate of the reason the panelist chose to add the topic.

Table 6 Number of topics added by panelists in Delphi round 1 by environmental category

<table>
<thead>
<tr>
<th>Number of Topics Added</th>
<th>Environmental Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>nonpoint source</td>
</tr>
<tr>
<td>4</td>
<td>solid waste</td>
</tr>
<tr>
<td>8</td>
<td>multi-media</td>
</tr>
</tbody>
</table>

Table 7 Number of topics added by panelists in response to Delphi round 1

<table>
<thead>
<tr>
<th>Number of Topics Added</th>
<th>Number of Panelists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Panelists’ Responses to Delphi Round 2

One panelist who responded to Round 1 failed to respond to Round 2. Several attempts to obtain this panelist’s response to Round 2 failed. The Round 2 non-respondent was a senior agricultural agency administrator, however the presence of 17 other Round 2 panelists from agricultural agencies was judged by the researcher to have minimized the non-response impact on the Round 2 results. The Round 2 responses of 40 panelists were evaluated.

If all 40 panelists had rated all 55 of the Round 1 topics and the 25 additional topics, there would have been a total of 3,200 topic ratings (40 x 80 = 3,200). Of the 80 topics, 29 topics (36%) were rated by all 40 panelists, 46 topics (58%) were rated by 39 panelists, 3 topics (4%) were rated by 38 panelists, and 2 topics (2%) were rated by 37 panelists as indicated in Table 8, or each topic received at least 37 ratings. This provided a total of 3,142 topic ratings or 98% of the maximum possible number of topic ratings. This is slightly higher than Round 1, again indicating a broadly-based evaluation of the 80 topics.

Table 8 Number of Delphi round 2 topics rated by number of panelists

<table>
<thead>
<tr>
<th>Number of Round 2 Topics Rated</th>
<th>Number of Panelists Rating Each Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>40</td>
</tr>
<tr>
<td>46</td>
<td>39</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
</tr>
</tbody>
</table>
Of the 40 panelists, 31 panelists (78%) rated all 80 topics, 6 panelists (15%) rated 79 topics, 2 panelists (5%) rated 78 topics, and 1 panelist (2%) rated 32 topics as indicated by Table 9. One panelist accounted for 48 (83%) of the 58 non-ratings. This was the same panelist who in Round 1, chose not to rate 23 topics which might be considered not in the panelist’ field of expertise. These 23 topics were also not rated in Round 2 and this panelist also rated none of the additional topics. There were fewer non-ratings on the Round 2 instrument than on the Round 1 instrument. This indicates panelists were thorough and conscientious in responding to the Round 2 instrument.

Table 9 Number of panelists rating number of Delphi round 2 topics

<table>
<thead>
<tr>
<th>Number of Panelists</th>
<th>Number of Topics Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>79</td>
</tr>
<tr>
<td>2</td>
<td>78</td>
</tr>
<tr>
<td>1</td>
<td>32</td>
</tr>
</tbody>
</table>

The letter to panelists (Appendix D) with the Round 2 instrument gave them the option of leaving their ratings of the 55 Round 1 topics unchanged. Of the 40 Round 2 panelists, 24 (60%) chose not to make any changes in their Round 1 ratings. Three panelists rated topics in Round 2 that they had failed to rate in Round 1 but did not change any of their Round 1 ratings. These 27 panelists may have felt comfortable with their Round 1 ratings and chosen not to change them or they may have not wanted to
take the time to compare their Round 1 rating with the panel’s mean rating and decide whether to make a change.

Thirteen panelists made a total of 156 changes, or an average of 12 topic rating changes per panelist, in their Round 1 topic ratings. Seven panelists changed 14 or more of their Round 1 ratings, accounting for 145 (93%) of the topic rating changes as indicated in Table 10. Two of these panelists were doctoral candidates, knew the Delphi survey was part of a dissertation, and may have felt obligated to expend extra effort on the Round 2 instrument. Each of these 13 panelists was either a senior-career or a mid-career staff person, indicating a high level of experience in environmental issues.

Table 10 Number of Delphi round 1 rating changes made by number of panelists in Delphi round 2

<table>
<thead>
<tr>
<th>Number of Panelists</th>
<th>27</th>
<th>4</th>
<th>1</th>
<th>1</th>
<th>2</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Ratings Changed</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>19</td>
<td>26</td>
</tr>
</tbody>
</table>

Of the 156 topic rating changes made, 154 (99%) moved closer to the mean of the panel’s Round 1 ratings, which had the effect of moving the Round 2 mean in that direction. In 110 cases, the panelist’s Round 2 rating was between the panelist’s Round 1 rating and the mean of the panel’s Round 1 rating for that topic. See row 1 of Table 11. These changes helped move the mean of the panel’s Round 2 rating in the direction of the change by the panelist, but beyond the mean of the panel’s Round 1 ratings. These 110 cases may represent a panelist’s opinion which was not strongly held and which was persuaded by the panel’s collective opinion to change toward the mean.
Table 11 Effect on movement of Delphi round 2 mean from changes by panelists in Delphi round 1 ratings

<table>
<thead>
<tr>
<th>Cases</th>
<th>Relative Positions of Panelists’ Round 1 and Round 2 Ratings and the Round 1 Mean</th>
<th>Effect on Round 2 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Round 1 Rating</td>
<td>Round 2 Rating</td>
</tr>
<tr>
<td>23</td>
<td>Round 1 Rating</td>
<td>Round 1 Mean</td>
</tr>
<tr>
<td>2</td>
<td>Round 2 Rating</td>
<td>Round 1 Rating</td>
</tr>
</tbody>
</table>

In 23 cases, the panelist's Round 2 rating for a topic was the next closest rating to the mean of the panel's Round 1 ratings, but was beyond the Round 2 mean, which provided a relatively increased effect in moving the mean of the panel's Round 2 ratings beyond the mean of the Round 1 ratings. See row 2 of Table 11. These 23 cases may also represent a panelist's opinion which was not strongly held and which was persuaded by the panel's collective opinion. The panelist may not have realized the impact on the Round 2 mean resulting from this change in rating.

In 21 cases, the panelist's Round 2 rating for a topic, while in the direction of the mean of the panel's Round 1 ratings, was actually further away from the mean than was the panelist's Round 1 rating. See row 3 of Table 11. This had a much greater effect in moving the mean of the panel's Round 2 ratings beyond the mean of the Round 1 ratings. These 21 cases represent a panelist taking the time to make a change but they may also represent carelessness on the part of the panelist in making the change.
In two cases, the panelist’s Round 2 rating was opposite in direction from the mean of the panel’s Round 1 ratings which would have helped move the panel’s Round 2 mean closer to the panelists’ Round 1 rating. See row 4 of Table 11. These two cases may represent panelists with very strongly held opinions who felt that the panel’s collective opinion was wrong and that the panelist could help correct the mistake.

In 116 cases, the panelist moved the Round 2 rating one place to the next closest rating on the scale. In 36 cases, the panelist moved the Round 2 rating two places, and in four cases, either 3 or 4 places as indicated in Table 12. The effect of one of 40 panelists moving a Round 1 rating one place on the rating scale would be a 0.025 (one divided by 40) change in the value of the Round 2 mean from the value of the Round 1 mean. The effect of moving a Round 1 rating either two, three or four places on the rating scale would be a 0.05, 0.075, or a 0.1 change, respectively in the value of the Round 2 mean. Extending this concept suggests that a one place change in the same direction by all 40 panelists would change the Round 2 mean by a value of 1.0.

Table 12 Number of cases where rating was changed one, two, three, or four places on the rating scale and potential effect on location of round 2 mean

<table>
<thead>
<tr>
<th>Number of Cases Where Ratings Were Changed</th>
<th>Number of Places Changed on Rating Scale</th>
<th>Effect on Location of Round 2 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>1</td>
<td>0.025</td>
</tr>
<tr>
<td>36</td>
<td>2</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.075</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 13 provides a summary of cases in Rounds 1 and 2 where a 0.025 change in the value of the mean could have resulted in a change in ranking of topics. Review of the Round 1 means in Table 14 reveals four cases where the mean of two topic ratings were the same, four cases where a 0.025 change could have caused two topic rating means to be the same, and 18 cases where a 0.025 change in topic rating means would have changed the ranking of topics.

Review of the Round 2 means in Table 15 reveals 12 cases where the means of two topics ratings were the same value and one instance where the means of three topics ratings were the same value. A change in one of these topic ratings by a panelist could result in a change in ranking of the topic. This would also be true of 31 other topics where the difference in means of topic ratings was less than 0.025 and two other topics where the difference in means was 0.025.

Table 13 Number of cases where the difference in means of topic ratings in Delphi rounds 1 and 2 was zero, less than 0.025, or equal to 0.025

<table>
<thead>
<tr>
<th>Delphi Round</th>
<th>Difference in Topic Rating Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Means of Delphi Round 1 topic ratings, the ranked distribution of topic ratings, and averages by environmental category demonstrate relative priorities assigned by panelists to environmental topics. The frequency of selection of each rating for the 55 topics demonstrates convergence of panelists' opinions about priorities.

The means of the 55 Round 1 topic ratings were calculated for provision to the Delphi panelists as part of the Round 2 instrument. Table 14 includes a list of topics ranked by Round 1 mean topic rating and the environmental category for each topic. Means of individual topic ratings ranged from a high of 6.268 out of a possible seven for private water well protection (drinking water category) to a low of 3.487 for dust from livestock operations (air quality category). A ranked distribution of the topic rating means is shown in Figure 3. When grouped into environmental categories, the average of the mean ratings for two drinking water topics was highest. This was followed by the averages for four point source topics, nine nonpoint source topics, 11 multi-media topics, six ground water topics, ten solid waste topics, and 13 air quality topics as in Figure 4.

The distribution of the frequency of panelists' selection of Round 1 ratings indicated the highest frequency was for a rating of five, followed by ratings of four, six, seven, three, two and one, respectively, as shown in Figure 5.
Table 14 Means of 55 Delphi round 1 environmental topic ratings

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic (and Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.268</td>
<td>private water well protection (drinking water)</td>
</tr>
<tr>
<td>2</td>
<td>5.902</td>
<td>nutrients (nonpoint)</td>
</tr>
<tr>
<td>3</td>
<td>5.900</td>
<td>declining aquifers (multi-media)</td>
</tr>
<tr>
<td>4</td>
<td>5.875</td>
<td>animal waste (nonpoint)</td>
</tr>
<tr>
<td>5</td>
<td>5.872</td>
<td>water conservation (multi-media)</td>
</tr>
<tr>
<td>6</td>
<td>5.769</td>
<td>drift (pesticide/air)</td>
</tr>
<tr>
<td>7</td>
<td>5.707</td>
<td>animal waste lagoon (point source)</td>
</tr>
<tr>
<td>8</td>
<td>5.590</td>
<td>sustainable agriculture (multi-media)</td>
</tr>
<tr>
<td>9</td>
<td>5.561</td>
<td>public water supply protection (drinking water)</td>
</tr>
<tr>
<td>10</td>
<td>5.561</td>
<td>soil erosion (nonpoint)</td>
</tr>
<tr>
<td>11</td>
<td>5.512</td>
<td>abandoned, improperly closed wells (ground water)</td>
</tr>
<tr>
<td>12</td>
<td>5.500</td>
<td>empty pesticide containers (solid waste)</td>
</tr>
<tr>
<td>13</td>
<td>5.488</td>
<td>leaking, underground storage tanks (ground water)</td>
</tr>
<tr>
<td>14</td>
<td>5.390</td>
<td>animal waste storage, non-lagoon (point source)</td>
</tr>
<tr>
<td>15</td>
<td>5.366</td>
<td>household sewage (nonpoint)</td>
</tr>
<tr>
<td>16</td>
<td>5.341</td>
<td>inadequate backflow protection (ground water)</td>
</tr>
<tr>
<td>17</td>
<td>5.325</td>
<td>out-of-date pesticides (solid waste)</td>
</tr>
<tr>
<td>18</td>
<td>5.220</td>
<td>pesticides (nonpoint)</td>
</tr>
<tr>
<td>19</td>
<td>5.205</td>
<td>livestock waste lagoons (odor/air)</td>
</tr>
<tr>
<td>20</td>
<td>5.154</td>
<td>wildlife habitat (multi-media)</td>
</tr>
<tr>
<td>21</td>
<td>5.122</td>
<td>animal feeding operations (point source)</td>
</tr>
<tr>
<td>22</td>
<td>5.105</td>
<td>biodiversity (multi-media)</td>
</tr>
<tr>
<td>23</td>
<td>5.103</td>
<td>coastal erosion (multi-media)</td>
</tr>
<tr>
<td>24</td>
<td>5.177</td>
<td>livestock waste (odor/air)</td>
</tr>
<tr>
<td>25</td>
<td>5.024</td>
<td>buried waste (ground water)</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 14 (continued)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic (and Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>4.974</td>
<td>energy conservation (multi-media)</td>
</tr>
<tr>
<td>27</td>
<td>4.872</td>
<td>carcass management (odor/air)</td>
</tr>
<tr>
<td>28</td>
<td>4.868</td>
<td>sustainable communities (multi-media)</td>
</tr>
<tr>
<td>29</td>
<td>4.854</td>
<td>carcass management (nonpoint)</td>
</tr>
<tr>
<td>30</td>
<td>4.850</td>
<td>used engine oil (solid waste)</td>
</tr>
<tr>
<td>31</td>
<td>4.850</td>
<td>contaminated fuel (solid waste)</td>
</tr>
<tr>
<td>32</td>
<td>4.756</td>
<td>oil, grease and solvents (nonpoint)</td>
</tr>
<tr>
<td>33</td>
<td>4.744</td>
<td>mercury (air deposition)</td>
</tr>
<tr>
<td>34</td>
<td>4.700</td>
<td>other used lubricants (solid waste)</td>
</tr>
<tr>
<td>35</td>
<td>4.675</td>
<td>stored product leachate (point source)</td>
</tr>
<tr>
<td>36</td>
<td>4.650</td>
<td>cane burning (smoke/air)</td>
</tr>
<tr>
<td>37</td>
<td>4.641</td>
<td>irrigation return flows (nonpoint)</td>
</tr>
<tr>
<td>38</td>
<td>4.590</td>
<td>increasing soil salinity (multi-media)</td>
</tr>
<tr>
<td>39</td>
<td>4.585</td>
<td>micro-organisms (nonpoint)</td>
</tr>
<tr>
<td>40</td>
<td>4.575</td>
<td>crop stubble burning (smoke/air)</td>
</tr>
<tr>
<td>41</td>
<td>4.575</td>
<td>used tires (solid waste)</td>
</tr>
<tr>
<td>42</td>
<td>4.564</td>
<td>nitrogen (air deposition)</td>
</tr>
<tr>
<td>43</td>
<td>4.550</td>
<td>forest burning (smoke/air)</td>
</tr>
<tr>
<td>44</td>
<td>4.525</td>
<td>carcasses (solid waste)</td>
</tr>
<tr>
<td>45</td>
<td>4.487</td>
<td>endangered species (multi-media)</td>
</tr>
<tr>
<td>46</td>
<td>4.333</td>
<td>livestock housing (odor/air)</td>
</tr>
<tr>
<td>47</td>
<td>4.184</td>
<td>crop residue (solid waste)</td>
</tr>
<tr>
<td>48</td>
<td>4.051</td>
<td>rising sea level (multi-media)</td>
</tr>
<tr>
<td>49</td>
<td>4.000</td>
<td>household trash burning (smoke/air)</td>
</tr>
<tr>
<td>50</td>
<td>3.951</td>
<td>salinity (ground water)</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 14 (continued)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic (and Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>3.927</td>
<td>sodium (ground water)</td>
</tr>
<tr>
<td>52</td>
<td>3.725</td>
<td>used poly or other plastic film (solid waste)</td>
</tr>
<tr>
<td>53</td>
<td>3.650</td>
<td>used plastic irrigation pipe (solid waste)</td>
</tr>
<tr>
<td>54</td>
<td>3.487</td>
<td>field plowing (dust/air)</td>
</tr>
<tr>
<td>55</td>
<td>3.487</td>
<td>livestock operations (dust/air)</td>
</tr>
</tbody>
</table>

Figure 3 Ranked distribution of means of 55 Delphi round 1 topic ratings
Figure 4 Average of Delphi round 1 topic ratings by environmental category

Figure 5 Frequency of selection by panelists of each rating in Delphi round 1
RESULTS OF DELPHI ROUND 2

Round 2 mean topic ratings are provided in Table 15. Private water well protection received the highest rating and dog kennels received the lowest rating. Several topics added by panelists in Round 1 received high ratings in Round 2. Conservation buffers/filter strips, cost-share for incentive-based conservation, and buffer zones were added in Round 1 and received the 9th, 10th, and 11th highest mean ratings in Round 2. The ranked distribution of mean topic ratings is shown in Figure 6.

The frequency with which the panel selected each rating, one through seven, is shown in Figure 7. A rating of five was selected most frequently followed by ratings of four, six, seven, three, two, and one, respectively. The frequency distribution for ratings of individual topics is an indication of consensus among panelists. High variability in either the number of ratings chosen or in the frequency of selection of adjacent ratings indicates little consensus. Figure 8 gives the frequency of ratings for private drinking water well protection which received the highest mean rating of any topic in Round 2. All of the ratings were four or higher, including 18 (45%) ratings of 6 or 7, the two highest ratings possible. Three (8%) of the ratings were 5 and one rating was 4. There were no ratings of one, two, or three. Almost all panelists agreed that private drinking water well protection was very important. Not only were the panelists in consensus as to its importance, but the mean of their ratings was 6.325 out of 7.0, by far the highest mean topic rating.

Figure 9 provides an example of a frequency distribution of ratings for a topic with a lower mean rating. Application of forest waste to farm land had the 48th highest mean rating but all of the ratings were three, four, five or six, with 30 (75%) of the
ratings of 4 or 5. This is an example of a topic where panelists were in consensus that it was only the 48th most important topic out of the 80 topics. Figure 10, coastal erosion, and Figure 11, land leveling education, are examples of topics where the frequency of selection of ratings indicates less consensus. Some degree of bi-modal distribution of rating frequency is observed. In addition, both of these topics received a relatively low mean rating. Coastal erosion had the 36th highest mean rating and land leveling education had the 69th highest mean rating. These four topics were selected for illustrative purposes because their frequency distributions exhibited the highest and lowest levels of consensus observed in Round 2. Lack of consensus may be an indication of ambiguity in the words used to represent the topic or of a lack of knowledge about the topic on the part of some panelists.

Category Ratings

The average of mean topic ratings was reported by major farm commodity topic categories (Table 16). In many cases, extension education programs will be targeted to specific farmer audiences such as livestock and poultry farmers, agronomic or horticultural crop farmers, or to farmers with interests in aquaculture or wildlife. When the topics were arranged in these categories, the average of 20 topics which used the words “livestock”, “animal”, “carcasses” or other words related to livestock and poultry operations was 4.768. The average of the 36 topics related to plant science was 4.830. The average of the 23 topics related to fish and wildlife management was 4.905.

The average of mean topic ratings was also reported by environmental category (Table 17 and Figure 12). The average of the two drinking water topics was highest followed by the average for four point source topics, 22 nonpoint source topics, 19
Table 15 Means of 80 Delphi round 2 environmental topic ratings

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic (and Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.325</td>
<td>private water well protection (drinking water)</td>
</tr>
<tr>
<td>2</td>
<td>5.850</td>
<td>nutrients (nonpoint)</td>
</tr>
<tr>
<td>3</td>
<td>5.850</td>
<td>declining aquifers (multi-media)</td>
</tr>
<tr>
<td>4</td>
<td>5.795</td>
<td>water conservation (multi-media)</td>
</tr>
<tr>
<td>5</td>
<td>5.775</td>
<td>animal waste (nonpoint)</td>
</tr>
<tr>
<td>6</td>
<td>5.769</td>
<td>drift (pesticide/air)</td>
</tr>
<tr>
<td>7</td>
<td>5.675</td>
<td>public water supply protection (drinking water)</td>
</tr>
<tr>
<td>8</td>
<td>5.625</td>
<td>animal waste lagoon (point source)</td>
</tr>
<tr>
<td>9</td>
<td>5.615</td>
<td>conservation buffers/filter strips (nonpoint)</td>
</tr>
<tr>
<td>10</td>
<td>5.564</td>
<td>cost-share for incentive-based conservation (multi-media)</td>
</tr>
<tr>
<td>11</td>
<td>5.564</td>
<td>buffer zones (nonpoint)</td>
</tr>
<tr>
<td>12</td>
<td>5.525</td>
<td>abandoned, improperly closed wells (ground water)</td>
</tr>
<tr>
<td>13</td>
<td>5.513</td>
<td>sustainable agriculture (multi-media)</td>
</tr>
<tr>
<td>14</td>
<td>5.500</td>
<td>retention of crop residue/no-till (nonpoint)</td>
</tr>
<tr>
<td>15</td>
<td>5.487</td>
<td>government regulations in agriculture (multi-media)</td>
</tr>
<tr>
<td>16</td>
<td>5.475</td>
<td>soil erosion (nonpoint)</td>
</tr>
<tr>
<td>17</td>
<td>5.462</td>
<td>technical and/or educational assistance (multi-media)</td>
</tr>
<tr>
<td>18</td>
<td>5.459</td>
<td>conservation of riparian zones (nonpoint)</td>
</tr>
<tr>
<td>19</td>
<td>5.450</td>
<td>empty pesticide containers (solid waste)</td>
</tr>
<tr>
<td>20</td>
<td>5.450</td>
<td>household sewage (nonpoint)</td>
</tr>
<tr>
<td>21</td>
<td>5.436</td>
<td>conservation tillage (nonpoint)</td>
</tr>
<tr>
<td>22</td>
<td>5.400</td>
<td>leaking, underground storage tanks (ground water)</td>
</tr>
<tr>
<td>23</td>
<td>5.385</td>
<td>holding irrigation water for settling before discharge (nonpoint)</td>
</tr>
<tr>
<td>24</td>
<td>5.375</td>
<td>inadequate backflow protection (ground water)</td>
</tr>
<tr>
<td>25</td>
<td>5.350</td>
<td>out-of-date pesticides (solid waste)</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
**Table 15 continued**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic (and Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>5.350</td>
<td>pesticides (nonpoint)</td>
</tr>
<tr>
<td>27</td>
<td>5.308</td>
<td>impact of ag production practices on water quality (nonpoint)</td>
</tr>
<tr>
<td>28</td>
<td>5.275</td>
<td>animal waste storage, non-lagoon (point source)</td>
</tr>
<tr>
<td>29</td>
<td>5.154</td>
<td>wildlife habitat (multi-media)</td>
</tr>
<tr>
<td>30</td>
<td>5.150</td>
<td>animal feeding operations (point source)</td>
</tr>
<tr>
<td>31</td>
<td>5.128</td>
<td>application of treated sewage sludge to farm land (solid waste)</td>
</tr>
<tr>
<td>32</td>
<td>5.103</td>
<td>livestock waste lagoons (odor/air)</td>
</tr>
<tr>
<td>33</td>
<td>5.103</td>
<td>biodiversity (multi-media)</td>
</tr>
<tr>
<td>34</td>
<td>5.103</td>
<td>application of ag processing waste to farm land (solid waste)</td>
</tr>
<tr>
<td>35</td>
<td>5.051</td>
<td>urbanization of rural areas (multi-media)</td>
</tr>
<tr>
<td>36</td>
<td>5.000</td>
<td>coastal erosion (multi-media)</td>
</tr>
<tr>
<td>37</td>
<td>4.974</td>
<td>livestock waste (odor/air)</td>
</tr>
<tr>
<td>38</td>
<td>4.950</td>
<td>buried waste (ground water)</td>
</tr>
<tr>
<td>39</td>
<td>4.949</td>
<td>sustainable communities (multi-media)</td>
</tr>
<tr>
<td>40</td>
<td>4.949</td>
<td>irrigation education (nonpoint)</td>
</tr>
<tr>
<td>41</td>
<td>4.897</td>
<td>energy conservation (multi-media)</td>
</tr>
<tr>
<td>42</td>
<td>4.846</td>
<td>carcass management (odor/air)</td>
</tr>
<tr>
<td>43</td>
<td>4.795</td>
<td>application of aquacultural waste to farm land (solid waste)</td>
</tr>
<tr>
<td>44</td>
<td>4.775</td>
<td>carcass management (nonpoint)</td>
</tr>
<tr>
<td>45</td>
<td>4.769</td>
<td>fish habitat (multi-media)</td>
</tr>
<tr>
<td>46</td>
<td>4.757</td>
<td>food crops (multi-media)</td>
</tr>
<tr>
<td>47</td>
<td>4.750</td>
<td>used engine oil (solid waste)</td>
</tr>
<tr>
<td>48</td>
<td>4.692</td>
<td>application of forest processing waste to farm land (solid waste)</td>
</tr>
<tr>
<td>49</td>
<td>4.678</td>
<td>contaminated fuel (solid waste)</td>
</tr>
<tr>
<td>50</td>
<td>4.675</td>
<td>oil, grease and solvents (nonpoint)</td>
</tr>
</tbody>
</table>
(Table 15 continued)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>4.641</td>
<td>cane burning (smoke/air)</td>
</tr>
<tr>
<td>52</td>
<td>4.641</td>
<td>management of small forested tracts (multi-media)</td>
</tr>
<tr>
<td>53</td>
<td>4.615</td>
<td>stored product leachate (point source)</td>
</tr>
<tr>
<td>54</td>
<td>4.600</td>
<td>micro-organisms (nonpoint)</td>
</tr>
<tr>
<td>55</td>
<td>4.600</td>
<td>other used lubricants (solid waste)</td>
</tr>
<tr>
<td>56</td>
<td>4.590</td>
<td>forest burning (smoke/air)</td>
</tr>
<tr>
<td>57</td>
<td>4.564</td>
<td>mercury (air deposition)</td>
</tr>
<tr>
<td>58</td>
<td>4.564</td>
<td>management of grazing lands (nonpoint)</td>
</tr>
<tr>
<td>59</td>
<td>4.538</td>
<td>increasing soil salinity (multi-media)</td>
</tr>
<tr>
<td>60</td>
<td>4.525</td>
<td>used tires (solid waste)</td>
</tr>
<tr>
<td>61</td>
<td>4.513</td>
<td>endangered species (multi-media)</td>
</tr>
<tr>
<td>62</td>
<td>4.500</td>
<td>livestock health practices (nonpoint)</td>
</tr>
<tr>
<td>63</td>
<td>4.487</td>
<td>nitrogen (air deposition)</td>
</tr>
<tr>
<td>64</td>
<td>4.487</td>
<td>crop stubble burning (smoke/air)</td>
</tr>
<tr>
<td>65</td>
<td>4.385</td>
<td>population growth (multi-media)</td>
</tr>
<tr>
<td>66</td>
<td>4.308</td>
<td>livestock/forest products marketing (multi-media)</td>
</tr>
<tr>
<td>67</td>
<td>4.308</td>
<td>land leveling education (nonpoint)</td>
</tr>
<tr>
<td>68</td>
<td>4.256</td>
<td>livestock housing (odor/air)</td>
</tr>
<tr>
<td>69</td>
<td>4.211</td>
<td>crop residue (solid waste)</td>
</tr>
<tr>
<td>70</td>
<td>4.051</td>
<td>rising sea level (multi-media)</td>
</tr>
<tr>
<td>71</td>
<td>4.000</td>
<td>household trash burning (smoke/air)</td>
</tr>
<tr>
<td>72</td>
<td>3.875</td>
<td>salinity (ground water)</td>
</tr>
<tr>
<td>73</td>
<td>3.825</td>
<td>sodium (ground water)</td>
</tr>
</tbody>
</table>
(Table 15 continued)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mean</th>
<th>Environmental Topic (and Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>3.625</td>
<td>used poly or other plastic film (solid waste)</td>
</tr>
<tr>
<td>77</td>
<td>3.590</td>
<td>livestock operations (dust/air)</td>
</tr>
<tr>
<td>78</td>
<td>3.575</td>
<td>used plastic irrigation pipe (solid waste)</td>
</tr>
<tr>
<td>79</td>
<td>3.538</td>
<td>field plowing (dust/air)</td>
</tr>
<tr>
<td>80</td>
<td>3.051</td>
<td>dog kennels (nonpoint)</td>
</tr>
</tbody>
</table>

Figure 6 Ranked distribution of means of 80 Delphi round 2 topic ratings

multi-media topics, six ground water topics, 14 solid waste topics, and 13 air quality topics, respectively. As environmental categories, the average of the topic ratings listed in drinking water, point source, nonpoint source, and multi-media categories were higher than the average of all 80 topics indicating categories of high relative
Figure 7 Frequency of selection by panelists of each rating in Delphi round 2

Figure 8 Frequency of selection by panelists of each rating for the private water well protection topic in Delphi round 2
Figure 9 Frequency of selection by panelists of each rating for the application of forest waste to agricultural land topic in Delphi round 2

Figure 10 Frequency of selection by panelists of each rating for the coastal erosion topic in Delphi round 2
Figure 11 Frequency of selection by panelists of each rating for the land leveling education topic in Delphi round 2

Table 16 Average of Delphi round 2 topic ratings by farm commodity categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Topics</th>
<th>Average of Mean Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock</td>
<td>20</td>
<td>4.768</td>
</tr>
<tr>
<td>All Topics</td>
<td>80</td>
<td>4.892</td>
</tr>
<tr>
<td>Plant Science</td>
<td>36</td>
<td>4.830</td>
</tr>
<tr>
<td>Fish and Wildlife</td>
<td>23</td>
<td>4.905</td>
</tr>
</tbody>
</table>

importance. The average of the ratings of topics listed in ground water, solid waste, and air quality categories were lower, indicating relatively lower importance. Figures 13-19 illustrate mean topic ratings within environmental categories.
Table 17 Average of Delphi round 2 topic ratings by environmental categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Topics</th>
<th>Average of Mean Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking Water</td>
<td>2</td>
<td>6.000</td>
</tr>
<tr>
<td>Point Source</td>
<td>4</td>
<td>5.166</td>
</tr>
<tr>
<td>Nonpoint Source</td>
<td>22</td>
<td>5.036</td>
</tr>
<tr>
<td>Multi-Media</td>
<td>19</td>
<td>5.008</td>
</tr>
<tr>
<td>All Topics</td>
<td>80</td>
<td>4.892</td>
</tr>
<tr>
<td>Ground Water</td>
<td>6</td>
<td>4.825</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>14</td>
<td>4.641</td>
</tr>
<tr>
<td>Air Quality</td>
<td>13</td>
<td>4.527</td>
</tr>
</tbody>
</table>

The agricultural agency panelists’ responses were compared with the non-agricultural agency panelists’ responses (Figure 20). This was done to examine the possibility of agency bias among panelists. A t-test showed no significant difference (p = 0.05) in environmental category average ratings by agricultural agency staff (USDA and LDAF staff) compared with non-agricultural agency staff (LDNR, LDWF, LDHH and LDEQ staff).

When the environmental category averages for senior staff from all agencies were compared with those for junior staff from all agencies, the senior staff rated five of the seven categories lower than did the junior staff. The senior staff rated nonpoint source and multi-media topics higher than did the junior staff as shown in Figure 21. A t-test showed no significant difference (p = 0.05) in environmental category average ratings by senior-career staff (more than 25 years of experience) compared with junior-career staff (less than 16 years of experience).
Figure 12 Average of Delphi round 2 topic ratings by environmental category

Figure 13 Means of Delphi round 2 topic ratings for drinking water category
Figure 14 Means of Delphi round 2 topic ratings for the nonpoint source category
Figure 15 Means of Delphi round 2 topic ratings for the point source category

Figure 16 Means of Delphi round 2 topic ratings for the ground water category

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Figure 17 Means of Delphi round 2 topic ratings for the air quality category

Figure 18 Means of Delphi round 2 topic ratings for the solid waste category
Figure 19 Means of Delphi round 2 topic ratings for the multi-media category
Figure 20 Comparison of agricultural agency staff and non-agricultural agency staff averages of Delphi round 2 topic ratings by environmental category

Figure 21 Comparison of senior-career and junior-career staff averages of Delphi round 2 topic ratings by environmental category
Comparison of Delphi Rounds 1 and 2 Results

The Delphi Round 2 instrument included the 55 environmental topics from the Delphi Round 1 instrument as well as the 25 topics added by panelists in Round 1. As indicated in Table 6, the added topics were included in nonpoint source, solid waste, and multi-media categories. A t-test found no significant differences (p = 0.05) between Rounds 1 and 2 environmental category averages when the 25 added topics were excluded. Figure 22 illustrates the similarity in category averages.

When the means of individual topic ratings within a category were compared, a t-test found significant differences (p = 0.02) between Rounds 1 and 2 for the solid waste category. Means of individual topic ratings in all other categories were not significantly different (p = 0.05).

When the three categories with added topics were compared, as in Figure 23, the category average for the 13 added nonpoint source topics was lower than the category averages for the 9 original nonpoint source topics included in the Round 1 and Round 2 instruments. Conversely, the category average for the four added solid waste topics were much higher than the category averages for the 10 original solid waste topics. The category average for the eight added multi-media topics was slightly lower than the category averages for the original 11 multi-media topics.

When the means of individual ratings of the 55 topics included in the Delphi Rounds 1 and 2 instruments were compared using a t-test, the Round 1 and Round 2 means were significantly different (p = 0.001). An illustration of the comparison of the 55 topic means from Delphi Rounds 1 and 2 in Delphi Round 1 sequence is provided in Figure 24.

148
Figure 22 Comparison of environmental category averages in Delphi rounds 1 and 2 excluding 25 added topics

Figure 23 Averages for nonpoint source, solid waste, and multi-media categories in Delphi rounds 1 and 2 (excluding added topics) and 25 added topics
Figure 24 Means of 55 Delphi rounds 1 and 2 environmental topic ratings
DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

Delphi Process

The Delphi process provided an inexpensive method of obtaining opinions about environmental topics which should be included in an education program for Louisiana farmers. Panelists chose one of seven ratings for each of 55 topics on the Round 1 instrument (Appendices A and B) and 80 topics on the Round 2 instrument (Appendices C and D). Ten panelists added 25 topics (Tables 6 and 7, and Appendix C) to the Round 1 instrument and 13 panelists made one or more changes to their Round 1 ratings (Tables 10, 11 and 12).

While the number of topics to be rated was high, the process did not take a lot of the panelist's time. When compared with attending a scheduled meeting of a Louisiana Cooperative Extension Service advisory committee, the investment by the panelist was minimal.

The Louisiana Cooperative Extension Service investment was minimal. A cover letter and two page instrument was mailed, faxed, or hand-delivered on two occasions by the researcher. Very few follow up calls were made. Data was recorded directly into a spreadsheet. Statistics were calculated, and charts prepared with the same spreadsheet. The process could probably be accomplished with ten man-days of effort expended over a 60-day time period.

The implication of these observations for extension is that the Delphi process is an efficient and inexpensive technique for complementing the traditional extension advisory committee process. This finding is consistent with the discussion of the Delphi
process by Delbecq, van de Ven, and Gustafson (1975), Linstone and Turoff (1975), Scheele (1975), and Scheibe, Skutsch, and Schofer (1975). The Delphi process should be considered by extension faculty as a substitute for, or a complement to, advisory committees, especially where panelists will be drawn from a wide geographic area where travel and time could limit participation. Extension should pursue electronic use of the Delphi process over the internet or through the web site.

Providing the Round 1 instrument as the first iteration of the Delphi process reduced the amount of time required by the panelists and may have introduced the panelists to a wider range of topics than they might have suggested. The low ratings for less well-known topics such as salinity and sodium in the ground water category (Figure 16), household trash burning, and dust from plowing and livestock operations (Figure 17), or used agricultural plastic (Figure 18), may be an indicator of topics that would not have appeared if panelists had begun the first iteration with a clean sheet of paper. Low ratings for dog kennels in the nonpoint source category (Figure 14), and for livestock/forest product marketing in the multi-media category (Figure 19) may be examples of topics of interest to individual panelists which were not issues of concern to other panelists. Dog kennels as an issue has been dealt with by LDHH Parish Sanitarians and county agents, none of whom were panelists. Livestock/forest product marketing is of interest to county agents and ag agency staff in rural parishes but may not have been considered an environmental topic by many panelists.

Population growth in the multi-media category (Figure 19) received a relatively low rating but is an example of a primary environmental issue which was not included on the Round 1 instrument. Including population growth in an education program may
have been a problem for some panelists. Rising sea level in the multi-media category (Figure 19) is an example of a primary environmental issue which was included on the Round 1 instrument but which received low ratings. It may be of more interest to rice and sugar cane farmers in coastal Louisiana. Both issues are long range in nature which may have contributed to the low ratings.

The implication of this observation is that provision of a well-prepared Round 1 instrument improves the efficiency of the process for both panelists and researcher. It gives the panelist an array of topics to respond to rather than asking them to generate a list. The Round 1 instrument may have restricted the creativity of panelists. Being provided with a blank piece of paper for Round 1 would have allowed the panelists to list topics as they come to mind. It would have taken more of their time and would have generated a broader range of topics as indicated by the 25 added topics. More iterations would be required, but the final result may be a more comprehensive listing of topics. If the researcher wants a selected list of topics rated in a short time frame, the Round 1 instrument should include them. If the researcher wants new ideas from the panelists, and has more time, the Round 1 instrument could be open-ended. The discussion by Delbecq, van de Ven, and Gustafson (1975), Linstone and Turoff (1975), Scheele (1975), and Scheibe, Skutsch, and Schofer (1975) is comprehensive.

When the means of the 55 topics included in both Rounds 1 and 2 were compared (Tables 14 and 15, Figure 24), there was a 0.037 average difference between the individual topic mean ratings. A paired t-test of the 55 individual means resulted in a significant difference (p < 0.001). Despite this statistic, an average difference of 0.037 has little practical impact on the result of the study. The largest single difference
between means was 0.179. This is approximately the result of eight panelists (20%) making a one-place rating change in the same direction. When the topics were grouped by environmental categories (Figure 22), the rank of the category averages did not change from Round 1 to Round 2. The small differences that appeared between Round 1 and Round 2 ratings for the 55 topics were the result of three panelists (8%) who rated Round 1 topics which they had failed to rate in Round 1, and 13 panelists (33%) who made 156 changes in their Round 1 ratings (Tables 10, 11, and 12).

The means of the 25 added topics were dispersed among the 55 topic means provided in the Round 1 instrument. All of the added topics were classified into the nonpoint source, solid waste, and multi-media categories (Table 6). While the highest added topic mean was the ninth highest overall, added topic means accounted for seven of the top 20 means. While the lowest topic mean was an added topic, only five of the 20 lowest topic means were added topics (Tables 14 and 15, and Figures 14 and 19). The average of the added topic ratings for the solid waste category was higher than either the Round 1 or Round 2 averages of the solid waste topics which were part of the initial 55 topics on the Round 1 instrument.

One implication of these observations with 40 panelists is that the process of voting on each topic independently results in a relatively stable ranking of priorities between iterations, even though there was one less panelist in Round 2 than in Round 1, and there were 25 more (45%) topics to rate in Round 2. A second implication is that the panel respected the topics suggested by ten (25%) of their members enough to rate them as highly as they did the initial list of 55 topics provided in the Round 1 instrument. A third implication is that the ten panelists who added topics felt strongly...
about the importance of the nonpoint source, solid waste, and multi-media categories. The categories used, and the classification of topics into categories by the researcher is an important part of helping the panelist understand the issues involved. If analysis is to be done on the basis of categories, it must also be recognized that classification is somewhat arbitrary. A topic which one person may consider point source may be considered nonpoint source by another. With 40 panelists, the Delphi process appears to be sufficiently robust to encourage its use by extension faculty.

**Delphi Panelists**

Responsiveness of potential panelists, measured as the percent of responses, decreased with seniority (Table 2 and Figure 1). This may indicate less expectation of value derived from participation in one more survey by senior-career staff, although they should be expected to recognize the value of education of their clientele to the accomplishment of their mission. Senior staffers may be more involved in non-topic issues. If seniority of panelists is desired, the potential panelist pool may need to be larger than if seniority is not needed.

Delbecq, van de Ven and Gustafson (1975) suggested that ten to fifteen panelists from a homogeneous group might be an adequate number and that few new ideas would be generated within a homogeneous group once the size of the panel exceeded thirty well-chosen participants. They suggested that a larger group may be useful if one of the purposes was to provide increased group understanding of the subject matter. Education of the panelists occurred only to the extent of their observation of the panel's results and their observation of the topics added by 13 panelists. These added topics might be considered the new ideas generated in this study. The opportunity exists for extension to
use the Delphi process to educate the panel by providing them with analysis of the results, and/or by inviting them to a meeting for further discussion of the topics.

Comparison of the category ratings of the 18 agricultural agency staff with those of the 23 non-agricultural agency staff (Figure 20), and of the 14 senior-career staff with those of the ten junior-career staff (Figure 21) indicated no significant differences ($p < 0.05$). The convergence of opinion between the groups does not necessarily imply homogeneity. If the panel had only included a total of 15 people divided between ag and non-ag agencies, and senior-career and junior-career status, significant differences may have been observed. Selection of members for smaller panels may require more care if convergence is desired. Scheibe, Skutsch and Schofer (1975) suggested that consensus among Delphi panelists was not required and that valuable information could also be derived from observation of disagreement among the experts.

Scheele (1975) suggested that the introduction of ambiguities or disruptions into the process could reduce the tendency of Delphi panelists to converge toward consensus. The listing of livestock waste topics under point source, nonpoint source, air quality, and solid waste categories, may have caused ambiguity. One panelist objected to crop residue being listed in the solid waste category. One panelist questioned stored product leachate as a topic. An explanation of topics may have been helpful.

Panelists provided 97% and 98%, respectively, of the maximum possible topic ratings on the Rounds 1 and 2 instruments (Tables 4, 5, 8 and 9). This may indicate strong support for the process, appreciation that their opinions were requested, or respect for the potential of education to make their jobs easier. It also means that each of the topics received a broadly-based review by a large number of highly-experienced
agency staff. Extension faculty should consider the motivation of potential panelists to actively support the Delphi process before choosing to use it.

Ten of the 41 panelists in Round 1 added 25 topics (Tables 1, 6, and 7). Thirteen nonpoint source topics were added to the 9 original nonpoint source topics. Since most of the ag agency staff, and many of the non-ag agency staff, work primarily with nonpoint source, and since this is the primary media of interest to farmers, this result is consistent with the mission of the agencies and the needs of the farmer. All four of the solid waste topics came from the same staff person who had responsibility for solid waste and represented a program jointly developed by extension, LDEQ and LDAF. The rationale for adding the multi-media topics could be divided between agency mission, farmer concerns, global concerns, and indeterminate categories. The implications are that a small number of the panelists will take the time to add topics. Some of the added topics will be valuable additions. The panelist should always be provided with the opportunity to add to the process and should expect that their efforts will be appreciated by the researcher.

Most (60%) of the panelists made no changes in their Round 1 ratings. It takes time to make changes and experienced agency staff may not feel a need to review their previous decisions. The thirteen panelists who made 156 changes were obviously willing to make an extra effort. A researcher finding this level of response may want to make an extra effort to thank those panelists and ask for their help in future research.

It is not apparent whether panelists who made changes understood the impact their changes could have had on the final results (Tables 11, 12, and 13). The large number of panelists reduced the impact of the changes as indicated by the lack of
change in the rank of the categories (Tables 4 and 12, and Figure 22), the small
differences between Round 1 and Round 2 means of individual topic ratings (Tables 14
and 15), and the plot of Round 1 and Round 2 means for the 55 topics (Figure 24). The
average of the ratings for the four added solid waste topics is higher than the average of
the ten solid waste topics rated in Rounds 1 and 2 (Figure 23). These four topics refer to
application of solid waste to farm land which is mutually beneficial to most parties and
has been generally supported by all agencies. When working with small panel sizes, the
researcher should carefully examine the potential impact of changes by panelists on
final results. A widely-distributed news story related to one or more topics between
rounds is just one example of events external to the Delphi process which could cause
panelists to change their ratings. An education program conducted for panelists between
rounds should produce changes in ratings and might be a method of evaluating the
education program.

Rounds 1 and 2

Private water well protection received the highest mean topic rating in both
Rounds 1 and 2 (Tables 14 and 15, and Figures 3 and 6). None of the agencies
represented on the panel has a technical or a regulatory responsibility for private water
wells. Public water supply protection, which is LDHH’s responsibility, received the
ninth and seventh highest mean topic ratings in Round 1 and Round 2, respectively.
Panelists may have assumed that public water systems were adequately protected,
whereas private wells were not, and that the farmer needed to know about private well
protection rather than public water system protection. Panelists may have given high
ratings to drinking water topics because of perceived health concerns. There have been
very few reported instances of contaminated private or public water wells in Louisiana. Other health risks were apparently not a major concern of panelists, as air quality received the lowest average rating of any category in Rounds 1 and 2 by the combined panel, by agricultural and non-agricultural agency staff, and by senior-career and junior-career staff (Table 17, and Figures 4, 12, 18, 20, 21, and 22). This finding is similar to the findings of the U. S. Environmental Protection Agency (1987 a,b,c,d,e) comparative risk surveys and may simply represent a lack of understanding by the panelists of comparative health risks associated with environmental topics. Panelists probably did not consider the well owner’s financial liability in the event of ground water contamination.

Nutrients received the second highest mean topic rating in both Round 1 and Round 2. Soil erosion received the 10th highest mean topic rating in Round 1 and the 16th highest mean topic rating in Round 2. Soil erosion is the largest nonpoint source contaminant followed by nutrients. Neither poses a health risk to humans. Neither can be eliminated, but like other nonpoint source pollutants, both can be reduced, and both are focal points of programs directed at storm water, TMDL, hypoxia, and harmful algal bloom issues, by staff representing the agricultural agencies, LDEQ, and LDNR.

Declining aquifers received the third highest mean topic rating in both Round 1 and Round 2. The Sparta Aquifer has been declining for as long as records have been kept. In addition, its decline has been noted frequently in the press in recent years. Production agriculture uses little of the Sparta Aquifer withdrawals. The Chicot Aquifer, on the other hand, has received very little notice in the press. Rice irrigation and aquaculture account for most of the water withdrawn from the Chicot and will
necessarily be involved in the declining aquifer issue. Only three of the panelists work in ground water and could not have, on their own, caused declining aquifers to have received the third highest rating.

Pesticide drift received the sixth highest rating in both rounds and was one of four topics which received the same mean rating in both rounds. This was the highest rating for an air quality topic. The next highest air quality topic rating in Round 1 was 27th and in Round 2 was 32nd. Air quality is the most serious environmental media from a human health perspective. Odor, as a part of air quality, has probably generated more complaints about farm operations, both in Louisiana and across the United States, than any other environmental media.

The implication for extension environmental education is that agency staff are one of many audiences. Because of their influence on regulatory policy and the potential for their agencies to fund and support environmental education programs, extension should consider agency staff as a major audience. The environmental issues that agency staff work with are frequently controversial. Agency staff need risk communication, collaboration, and group dynamics skills training as much or more than any other extension audience. They should receive high priority for skills training as well as for subject matter training. LDHH Parish Sanitarians are the only state agency staff located in each parish. In some cases they are located in the same building with extension faculty. The Parish Sanitarians have more expertise in many environmental topic areas with human health risks, such as household sewage systems, drinking water safety, backflow protection, lead paint, and restaurant and food processing plant sanitation, than anyone else in the parish. This is especially true in rural parishes. In some cases,
LDHH has regulatory authority. LDHH Parish Sanitarians should be both a primary audience and primary technical resource person for extension environmental educators.

The topic with the lowest mean rating in Round 2 was dog kennels. There have been odor complaints about dog kennels in several specific parishes. The problem has been addressed by LDHH Parish Sanitarians and very few agency staff outside LDHH could be expected to be familiar with the problem. Dog kennels was added by an experienced LDEQ staff person. The implication is that an open-ended request for topics will result in some which are local in nature and of concern to few panelists. The researcher must take this into account in constructing the instrument.

**Conclusions**

Objectives 1 and 2: Environmental education in the United States and in Louisiana.

Environmental education has been traditionally characterized as a component of K-12th grade formal education which has been strongly supported by university and college faculty in schools of education and by staff of state agencies and non-profit organizations. The most prominent nonformal training for teachers has been Project Learning Tree sponsored by the Louisiana Department of Agriculture and Forestry (1996) and Project WILD and Project Aquatic WILD sponsored by the Louisiana Department of Wildlife and Fisheries (2000). Business and industry have supported formal and nonformal environmental education, have hired graduates of university environmental programs, and have trained their own staff in environmental sciences.

Numerous surveys indicated the gap between public perception and environmental science which provided the need for environmental education. In addition to education needs in all schools, Hair’s survey (1996) found stronger
programs in East Baton Rouge Parish than in rural schools. The NCEET survey suggested that both rural teachers and urban, inner-city teachers were not well-reached by in-service training in environmental education. Extension has an opportunity to help in both areas.

Ozone non-attainment areas, gasoline additives, auto manufacturers’ pursuit of energy efficient vehicles, increasing rates of asthma, highly visible open burning of sugar cane and other crops, and frequent complaints about odors and dust have raised the public interest in air quality standards.

The Clean Water Action Plan (Browner and Glickman, 1998) and the TMDL implementation process (Hebert, 1999) represented significant increases in the visibility of existing water quality regulations and increased the need for farmers to understand the changes that are taking place and to be prepared to meet them.

Increasing urbanization and land prices, declining numbers of commercial farms, continued emergence of large and/or vertically integrated farms, increasing numbers of hobby farms, and less awareness by the public of agricultural production have continued to increase pressure on farmers to avoid environmental conflicts.

Farmers, foresters, municipal officials and small businesses in rural areas have demonstrated a need for environmental education.

Objective 3: Extension education programming models

Traditional extension education programming models were appropriate for environmental education programming. Bennett (1992) made strong points about extension’s unique ability to provide education and skills training, not just technology transfer, and about extension’s credibility with its audiences. He pointed out the need to
network with other agencies and organizations through advisory committees especially where there is no research base for much of the information that must be conveyed.

Mayeske (1993) encouraged planning a finite life expectancy for education programs. With the rapid pace of change, he said educators had to be ready to begin new programs which means some old programs have to be turned over to volunteers, to other agencies or organizations, or abandoned. He also encouraged and demonstrated a rigorous program design process.

Bergsrud, Casey, and Krueger (1989) pointed out the need of extension faculty for water quality subject matter training as well as for process and strategic skills training. Halbert and Hovey (1994) provided a workshop called Building Common Ground for developing collaboration skills. The TAXI program (U. S. Department of Agriculture, 1995) provided guides for recruiting, developing, retaining and rewarding volunteers. The Agricultural Leadership Program, the Community Leadership and Economic Development program, the Issues Forum training, and many of the 4-H youth programs such as Challenge Camp, Marsh Maneuvers, Wild Woods Wanderings, and the Environmental Threat Resolution Contest (LSU AgCenter, 1999) provided training for extension faculty, youth and adults.

Observation of trends in use of natural resources, agriculture, litigation, and communications, and training in futuring, have helped the extension educator anticipate emerging environmental issues and prepare appropriate education programs.

Objective 4: Subject matter content for an environmental education program for farmers

Highest priorities were given to drinking water topics and lowest priorities to air quality topics. This is in accordance with public perception and is contrary to apparent
public health risks as indicated by the comparative risk surveys. This represents the gap referred to by Tyler (1949) between what is and what should be. This is the gap that supports the need for environmental education.

Panelists were apparently unaware of a number of topics with low ratings such as sodium and salinity in ground water. They were less concerned with global issues such as endangered species, population growth, and rising sea level. They were less concerned about dust from plowing fields and livestock operations, smoke from prescribed burning of cane, crop stubble, and forests, and disposal of used poly or irrigation tubing. Agency staff awareness of these topics needs to be enhanced.

**Recommendations For Further Research**

Evaluate individual panelist’s ratings of topics and compare with demographics such as age, formal training, and career and job characteristics, to determine biases.

Evaluate panelists’ ratings of topics by agency. Compare with agency mission, and with responses of panelists in other agencies.

Evaluate characteristics of panelists who chose to make changes in their Round 1 ratings, as opposed to those who made no changes, and of those who chose to make large numbers of changes.

Apply statistical techniques for quantifying consensus and divergence among panelists in assigning ratings to individual topics, and to categories of topics.

Use statistical technique for evaluating changes in ranking of ratings.

**Recommendations for Extension Environmental Education**

Develop an environmental education curriculum for farmers focusing on the prioritized set of environmental topics rated by the Delphi panelists. Private water well
protection, point source and nonpoint source categories should receive high priority for program efforts because of the potential for TMDL implementation to affect farm operations. Include training in toxicology in all environmental education programs so that a science-based understanding of comparative health and sustainability issues can develop in all audiences.

Design a training program for extension environmental education faculty to prepare them to deliver the prioritized environmental topics, and to help audiences develop process and strategic skills.

Apply Delphi technique to determine environmental topic priority of other sets of audiences such as county agents, research faculty, LSU AgCenter administrators, farmers, crop consultants, agri-business representatives, non-agri-business representatives, municipal and parish officials, science teachers, youth, environmental groups, and the general public. Use representatives of those audiences as Delphi panelists.

Conduct subject matter and skills training for Delphi panelists from agencies, with special training and attention provided to LDHH Parish Sanitarians in order to increase the cooperative efforts between them and extension agents.

Develop an environmental education curriculum for other audiences.

Increase cooperation with schools and other agencies, non-governmental organizations, and the private sector in support of education in general, and environmental education in particular.
REFERENCES


167


Kentucky Association for Environmental Education. (1989). This uncommon opportunity: An environmentally literate Kentucky [Brochure]. Louisville, KY: Environmental Literacy Project.


<http://www.dhh.state.la.us/>

<http://www.dnr.state.la.us/>

<http://www.dotd.state.la.us/water/direct_frn.html>

<http://www.wlf.state.la.us/apps/netgear/page58.asp>


APPENDIX A: LETTER TO PANELISTS AND INSTRUMENT FOR DELPHI
ROUND 1

182
Dear Panelist:

You have helped the Louisiana Cooperative Extension Service with environmental education for farmers and other audiences for many years. Public interest and changes in state and national legislation will increase the need for environmental education directed to agricultural producers in the years to come. I want to focus our efforts on the most important environmental topics for various audiences and would like your help.

I am asking you and other agency professionals to serve as a panel of experts to look at the enclosed list of environmental topics and rate each one as to how important you think it is for an extension environmental education program targeting farmers as the audience. Please assign a number from 1 to 7 to each topic with 1 being your evaluation of a topic as having lowest importance and 7 being of highest importance. If you wish to add a topic or comments, please feel free to do so.

I will summarize the results of the expert panel evaluation and return them to you for a final evaluation. The results will be reported to our faculty and administration and used to improve extension’s environmental education programming.

You can return your evaluation by mail to me at P.O. Box 25100, Baton Rouge, LA 70894-5100, by fax at 225.388.2478, or by e-mail at bbranch@agctr.lsu.edu.

Thank you in advance for your help and please call (225.388.6998) if you have any questions.

Sincerely,

Bill Branch

Enclosure
Please circle one number from 1 to 7 for each numbered topic indicating your estimation of the topic’s importance for inclusion in an extension environmental education program for farmers. Circling a 1 indicates you do not feel the topic is important for inclusion in our educational programs for farmers. A higher number indicates you feel the topic is more important.

<table>
<thead>
<tr>
<th>Media</th>
<th>Category</th>
<th>Topic</th>
<th>Not important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drinking water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. private water well protection</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. public water supply protection</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonpoint source or storm water runoff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. soil erosion</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. nutrients</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. pesticides</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. animal waste</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. oil, grease, solvents</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. household sewage</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. irrigation return flows</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. micro-organisms</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. carcass management</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Point source discharges</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12. animal waste lagoon</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13. animal waste storage (other than lagoons)</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14. animal feeding operations</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15. stored product leachate</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ground water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16. abandoned, improperly closed wells</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17. leaking, underground storage tanks</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18. buried waste</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19. inadequate backflow protection</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20. salinity</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21. sodium</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smoke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21. cane burning</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>22. forest burning</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23. crop stubble burning</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24. household trash burning</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dust</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25. field plowing</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>26. livestock operations</td>
<td>1-2-3-4-5-6-7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Odor
27. livestock housing 1–2–3–4–5–6–7
28. livestock waste 1–2–3–4–5–6–7
29. livestock waste lagoons 1–2–3–4–5–6–7
30. carcass management 1–2–3–4–5–6–7

Pesticide
31. drift 1–2–3–4–5–6–7

Aerial deposition
32. mercury 1–2–3–4–5–6–7
33. nitrogen 1–2–3–4–5–6–7

Solid and Hazardous Waste
34. used engine oil 1–2–3–4–5–6–7
35. other used lubricants 1–2–3–4–5–6–7
36. old tires 1–2–3–4–5–6–7
37. empty pesticide containers 1–2–3–4–5–6–7
38. used plastic irrigation pipe 1–2–3–4–5–6–7
39. used poly or other plastic film 1–2–3–4–5–6–7
40. out of date pesticides 1–2–3–4–5–6–7
41. contaminated fuel 1–2–3–4–5–6–7
42. crop residue 1–2–3–4–5–6–7
43. carcasses 1–2–3–4–5–6–7

Multi-Media
44. sustainable agriculture 1–2–3–4–5–6–7
45. sustainable communities 1–2–3–4–5–6–7
46. biodiversity 1–2–3–4–5–6–7
47. endangered species 1–2–3–4–5–6–7
48. wildlife habitat 1–2–3–4–5–6–7
49. declining aquifers 1–2–3–4–5–6–7
50. increasing soil salinity 1–2–3–4–5–6–7
51. coastal erosion 1–2–3–4–5–6–7
52. rising sea level 1–2–3–4–5–6–7
53. energy conservation 1–2–3–4–5–6–7
54. water conservation 1–2–3–4–5–6–7

Additional Topics
1–2–3–4–5–6–7
1–2–3–4–5–6–7
1–2–3–4–5–6–7
1–2–3–4–5–6–7

Comments

Name of Respondent
APPENDIX B: EXPLANATION OF TOPICS IN DELPHI ROUND 1
INSTRUMENT
Category-Drinking water

1. private water well protection—Many farmers depend on private wells for their family drinking water supply and, in some cases, for water for their livestock and poultry, or for crop irrigation. Inadequate backflow protection or an improperly sealed well could allow contamination from surface water resulting in a potential health hazard to the family, livestock and poultry. Clean up of contaminated ground water is prohibitively expensive and could easily lead to bankruptcy. Private water wells must be drilled and abandoned water wells must be closed by a licensed contractor according to regulations enforced by the Louisiana Department of Transportation and Development (LDOTD). No agency routinely tests water samples from private water wells. The owner or user must arrange for testing.

2. public water supply protection—Some farmers are connected to a public water supply for household use and, in some cases, for watering livestock and poultry, or for irrigating small vegetable, ornamental, fruit or nut acreages. Inadequate backflow protection could lead to contamination of the public water system with health risks to the farm family as well as to neighbors. Lawsuits for damages could result. The Wellhead Protection Program and Source Water Assessment Program implemented by the Louisiana Department of Environmental Quality (LDEQ) under the Safe Drinking Water Act can restrict certain land use practices within a specified radius of a public water supply well, or upstream of a surface source public water supply. Assistance to public water supplies is provided by the Louisiana Rural Water Association, the Louisiana Department of Health and Hospitals (LDHH), and the USDA Rural Development and Rural Utility Services agencies. Standards for water quality provided

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
by public water supplies are set by the U. S. Environmental Protection Agency (USEPA) and by the LDHH.

**Category-Nonpoint source water quality**

3. soil erosion-Soil eroded from land is the largest nonpoint source pollutant by weight. Soil erosion can lead to sedimentation of drainage systems resulting in increased flooding and sediment removal cost. Turbidity from suspended soil particles may cause a surface water to be listed as impaired or not meeting its intended uses which could lead to sanctions against land owners. Sediment may also create an oxygen demand in the water from organic matter and nitrogen which may be attached to it. Regulatory authority for nonpoint source water pollution state-wide resides in the LDEQ and, in the Coastal Zone, with the Louisiana Department of Natural Resources (LDNR). The soil is the primary natural resource used in agricultural production. Soil erosion reduces farm productivity. Assistance in reducing soil erosion is provided by the USDA Natural Resources Conservation Service (NRCS), Farm Services Agency, and Agricultural Research Service, and the Louisiana Department of Agriculture and Forestry.

4. nutrients-Nutrients are the second largest nonpoint source pollutant by weight. Phosphorus in fresh, surface water causes eutrophication. Phosphorus removal from surface water is extremely slow and expensive. Nitrogen, phosphorus and silicates have been implicated in harmful algal bloom production in salt water. Hypoxia, red tide and pfiesteria are examples. The Louisiana Department of Agriculture and Forestry (LDAF) has regulatory authority over some aspects of fertilizer sales. Comprehensive Nutrient Management Plans have been required under some states’ legislation.
5. Pesticides - Pesticides are a relatively minor nonpoint source pollutant by weight, but the major pollutant in notoriety and potential health effects. The LDAF regulates pesticide usage. Integrated pest management is a widely used BMP.

6. Animal waste - Manure from animals grazing on pastures or manure and bedding spread on pastures and other land is a source of organic matter, nutrients and fecal coliform in runoff. This is also true of waste from pets in residential areas and from wild animals or birds in natural habitats. The USDA NRCS or the LDAF establishes limits on application rates in the animal waste management plans that it prepares.

7. Oil, grease, solvents - Used engine or hydraulic oil, grease and solvents create an oxygen demand in surface water. They can be toxic to vegetation, birds and animals. They create aesthetic impairment.

8. Household sewage - Individual household sewage is a source of organic matter, nutrients, oil and grease, and fecal coliform. The LDHH regulates the type and size of individual household sewage treatment systems and licenses contractors.

9. Irrigation return flows - Tail water from irrigation of crops contains nutrients, organic matter and pesticides. It is water that has been pumped and not used by the crop thus wasting both water and energy and increasing the cost of irrigation.

10. Micro-organisms - Bacteria, fungi, viruses and other micro-organisms from manure and other wastes and from soil and plant material may be toxic to birds, animals or humans. Fecal coliform is the indicator organism used for determining suitability of a surface water for swimming or fishing. Its presence may indicate contamination of water by fecal material although some organisms test positive as fecal coliform without a fecal connection. The LDHH and the LDEQ jointly issue postings of surface waters.
when fecal coliform levels exceed certain levels. The LDHH and the Louisiana Department of Wildlife and Fisheries issues similar postings for marine fisheries.

11. carcass management—Improper management of carcasses can be a source of nonpoint source pollution. The LDAF has responsibility for agricultural carcass management.

Category—Point source discharges

12. animal waste lagoon—Dairy, hog, alligator and poultry (table egg) farms may use anaerobic and/or aerobic lagoons to manage animal waste. If these lagoons discharge off the farm other than due to rainfall exceeding a 24 hour, 25 year storm, they are subject to point source discharge permits. Very large Confined Animal Feeding Operations (CAFOs) have been issued individual discharge permits by the USEPA Region 6 even though they are not allowed to have a discharge except in the event of a 24 hour, 25 year storm. Smaller animal feeding operations have been issued permits by the LDEQ under a general permit. Discharge sampling and testing, and monitoring reports are required as well as permit fees. Animal feeding operations with “no-discharge” systems certified by the USDA NRCS or by a consulting firm have not required a permit.

13. animal waste storage (other than lagoons)—A Confined Animal Feeding Operation (CAFO) may require a point source discharge permit regardless of whether or not the animal waste is stored as a liquid. Bedding from a horse stable or a broiler house could require a permit if the stable or house was classified as a Confined Animal Feeding Operation. Such a permit would be issued by LDEQ.

14. animal feeding operations—An animal feeding operation not classified as a CAFO can be required to obtain a point source discharge permit if the Secretary of the LDEQ determines that the animal feeding operation is a significant source of water pollution.
15. stored product leachate-Any stored product such as rice hulls or cotton gin trash which leaches significant quantities of pollutants could be required to obtain a point source discharge permit from the LDEQ.

Category-Ground water

16. abandoned, improperly closed wells-An abandoned, improperly closed well provides a direct conduit for any pollutant smaller than the casing diameter to reach ground water. It poses a significant liability for the land owner who is responsible for its proper closing. Except for a few specific exceptions, a licensed water well contractor is required to close the well in accordance with the specifications established by the legislature and enforced by the LDOTD. While a small domestic well might be properly closed for a few hundred dollars, a large irrigation well can cost several thousand dollars for proper closure. The potential liability for contamination of ground water, is much greater than the cost of closure.

17. leaking, underground storage tanks-Underground farm fuel storage tanks smaller than 1,100 gallon capacity have been exempted from regulation, however, a leaking underground storage tank can be very expensive to remediate. Regulation is by the LDEQ. Above ground storage tanks may be regulated by the LDAF or by the Louisiana Fire Marshal depending on the material being stored.

18. buried waste-Any buried waste can leach heavy metals, nutrients or other elements to ground water. Solid or hazardous waste is generally under the jurisdiction of the LDEQ although specific wastes may be regulated by the LDAF or the LDNR.

19. inadequate backflow protection-When a water system loses pressure, the water in the water lines can flow back toward the power source due to a siphon effect.
contaminant in a tank, sink or pond into which a hose connected to the water system has been placed, can backflow into the water system. An air gap is the only positive prevention practice. Check valves, anti-siphon valves, and reduced pressure valves may be required by plumbing and/or building codes to reduce the possibility of backflow.

20. salinity-Because Louisiana was formed by alluvial deposits into what is now known as the Gulf of Mexico, the sub-surface geology frequently contains high levels of salt. A water well may deliver high salinity water. Crops such as rice, corn and some varieties of soybeans are sensitive to salt. Irrigation water with high levels of salt could reduce the productive capacity of the soil to which it is applied. Surface water close to the Gulf may also contain high levels of salt, especially during periods of low rainfall. Since salt water is more dense than fresh water, it tends to occur at greater depths. Thus a bayou or river may have fresh water at the surface and salt water at the bottom if the water is not well mixed.

21. sodium-Sodium usually occurs along with salt. High levels of sodium in drinking water can be harmful to humans or animals. Some plants such as blueberries are sensitive to sodium and may be adversely affected by its presence.

Category-Air quality

Sub-category-Smoke

22. cane burning-Sugar cane leaves may be burned in the field to facilitate harvesting and reduce the amount of material hauled to the sugar mill and then hauled back to the field or to some other location as a waste. Agricultural burning is regulated by the LDAF and training for burn managers has been provided by the LSU AgCenter.
23. forest burning—Understory in timber tracts may be burned periodically to reduce fire hazard, improve tree growth and wildlife habitat. Prescribed forest burning is regulated by the LDAF.

24. crop stubble burning—Crop residue left after harvesting may be burned in accordance with regulations of the LDAF.

25. household trash burning—Household trash burning is allowed in less populated areas in accordance with parish regulations.

Sub-category—Dust

26. field plowing—Dust may occur from tillage/harvesting operations creating an aesthetic or respiratory problem. Dust blowing across roads could cause a traffic hazard.

27. livestock operations—Cattle movement in dry weather may create dust.

Sub-category—Odor

28. livestock housing—Animal Feeding Operations may generate odors depending on management practices used. Odors could be regulated by either the LDEQ or the LDAF.

29. livestock waste—Livestock and poultry waste management may generate odors depending on management practices used.

30. livestock waste lagoons—Livestock waste lagoons may generate odors when over loaded or during pumping or unusual weather conditions.

31. carcass management—Livestock and poultry carcass management may generate odors depending on management practices used.

Sub-category—Pesticide

32. drift—Pesticide application in windy conditions can result in drift to a non-intended host. Regulation of pesticides is the responsibility of the LDAF.
Sub-category-Aerial deposition

33. mercury-Mercury has been found in fish tissue. It is possible that the mercury was ingested by fish as a result of the deposition of airborne mercury into water. The incineration of wastes containing mercury, such as some batteries, may be the source.

34. nitrogen-Rainfall may be a significant source of nitrogen for surface waters in the eastern United States. Decomposition of organic matter may be a source of nitrogen in the atmosphere.

Category-Solid waste

35. used engine oil-Oil sprayed on vegetation can restrict its growth or kill the plant. Oil spread on the surface of water may restrict oxygen transfer. Small amounts of heavy metals worn off engine components or present in fuel are in used engine oil. Oil can be recycled, re-refined or burned for fuel.

36. other used lubricants-Same as used engine oil above.

37. Used tires-Used tires can collect rain water providing a breeding ground for mosquitoes. If tires start to burn, the fire is difficult to stop, creates heavy smoke, and the residue is difficult to clean up. Used tires are regulated by LDEQ.

38. empty pesticide containers-Used pesticide containers cannot be used for other purposes. They must be managed in accordance with label instructions.

39. used plastic irrigation pipe-Plastic pipe can be a source of water for mosquito breeding, a shelter for rodents, or fuel for a fire.

40. used poly or other plastic film-Same as plastic pipe above.

41. out of date pesticides-Out of date pesticides may be unstable. They may break down into other compounds. Containers may leak.
42. contaminated fuel-Contaminated fuel may harm an engine if used, and it may be improperly disposed of similar to used engine oil. It is flammable, creating a fire hazard.

43. crop residue-Stalks and other crop residue may be left on the surface of the soil to be naturally recycled as a source of nutrients and organic matter. They may serve as a mulch to reduce evaporation of soil moisture.

44. carcasses-Improperly managed livestock and poultry carcasses may be a source of microbial infection of other animals, odors, organic matter and nutrients. They may attract vectors which may be harmful to other animals.

45. sustainable agriculture-Sustainable agriculture may be defined as a system of crop production which maintains and/or enhances the health and quality of the soil, water, air, plant, animal and human resources it utilizes or benefits.

46. sustainable communities-Communities which conserve natural resources for future consumption, and preserve or enhance the quality of life might be considered sustainable.

47. biodiversity-Consideration and conservation of the diverse array of organisms that naturally occur in a habitat might be considered biodiversity.

48. endangered species-The survival of some species of plants and animals has been threatened by human activities. Federal legislation prohibits practices which threaten or endanger the survival of these species. The U. S. Fish and Wildlife Service of the U. S. Department of the Interior has responsibility for enforcing these regulations.

49. wildlife habitat-Clearing forests, filling wetlands, and deposition of sediment in surface waters may eliminate or reduce habitat for fish and wildlife.
50. declining aquifers—Water in the Sparta Aquifer in north central Louisiana has been withdrawn faster than the recharge rate for many years. The Chicot Aquifer in southwest Louisiana declines annually during the summer and normally recharges in the winter. Reduced annual rainfall during recent years has increased concern.

51. increasing soil salinity—Ground water frequently includes high levels of salt. Irrigation may increase soil salinity.

52. coastal erosion—Subsidence, loss of vegetation to nutria, and erosion caused by human activities and storms cause large losses of coastal land annually.

53. rising sea level—Increasing global temperatures and melting ice caps may be contributing to a rise in the mean sea level elevation.

54. energy conservation—Fossil fuels provide most of our energy. Supplies are finite. Conservation and alternative sources are important issues.

55. water conservation—Water conservation practices can reduce water consumption, thus lessening pressures on aquifers and the use of energy to extract and deliver the water.
APPENDIX C: TOPICS ADDED BY PANELISTS IN ROUND 1
1. government regulations in agriculture—Concern that rules and regulations will restrict farm management decisions. (multi-media)

2. cost-share programs to provide for voluntary incentive-based conservation—Concept of providing reimbursement for part of cost of installation of practices to conserve soil, water and other resources. (multi-media)

3. availability of technical and/or educational assistance for agriculture—Support for technical assistance from USDA NRCS and LDAF Office of Soil and Water Conservation, and educational assistance from the LCES, to farmers for installation of conservation practices. (multi-media)

4. impacts of agricultural production practices on water quality—Concern for effects of cultural practices on soil erosion, and loss of chemicals, organic matter and other wastes in runoff to receiving waters. (nonpoint)

5. management of grazing lands—Use of practices which reduce soil erosion and runoff from cattle on pasture into receiving waters. (nonpoint)

6. management of small forested tracts—Use of forest management practices to minimize soil erosion and loss of organic matter into receiving waters. (nonpoint)

7. livestock health practices—Proper management and disposal of used livestock health materials and supplies. (nonpoint)

8. livestock/forest products marketing—Marketing of waste products from livestock and forest production. (multi-media)

9. population growth—Concern that human population growth may exceed the earth’s carrying capacity. (multi-media)
10. urbanization of rural areas-Urban sprawl removing farm land from production and extending built-up areas and transportation systems. (multi-media)

11. irrigation education-Growers need to increase returns to investment in irrigation to increase sustainability, reduce amount of water and energy used, and the amount of water discharged from field. Growers need to be aware of high salt, sodium and/or pH levels in ground water and to provide backflow protection. (nonpoint)

12. land leveling education-Excessive cuts may expose poor subsoils. Excess slope may increase soil erosion. Improved drainage and irrigation efficiency may improve sustainability. (nonpoint)

13. conservation buffers/filter strips-Practices used to slow runoff and filter sediments to reduce pollution of surface waters. (nonpoint)

14. conservation tillage (relates to crop residue)-Reduced tillage and maintenance of higher levels of organic matter on and in the soil may improve soil quality. Reduced use of equipment, labor and fuel may improve sustainability. (nonpoint)

15. fish habitat-Maintenance of high quality water conditions, such as high dissolved oxygen, neutral pH, and water clarity can enhance fish populations. (multi-media)

16. food crops-Concern for sustainability of food production. (multi-media)

17. dog kennels-Odor complaints received from neighbors of commercial kennels. Rainfall runoff may carry waste to receiving waters. (nonpoint)

18. conservation of riparian zones-Use of practices which will reduce pollutant loadings from land located beside surface waters. (nonpoint)

19. buffer zones-Use of non-tilled, vegetative strips of land between crop land or waste applications and surface waters to reduce pollutant loading. (nonpoint)
20. retention of crop residue/no-till farming-Leaving crop stubble on soil surface to serve as mulch and source of plant nutrients and minimizing tillage. (nonpoint)

21. holding irrigation water on rice fields to allow settling before discharge-Practices used to reduce sediment loading into receiving waters from irrigation. (nonpoint)

22. application of crawfish, catfish and aquacultural wastes to farm land-Irrigation with waste water and/or spreading solid waste from aquacultural or marine fisheries processing on farm land for its nutrient value rather than treating the waste water for discharge or hauling the solid waste to a landfill. (solid)

23. application of forest processing wastes to farm land-Same as above for paper mill or timber processing wastes and waste water. (solid)

24. application of agricultural commodity processing waste to farm land. Same as above for waste water and solid wastes from food and fiber processing. (solid)

25. application of treated sewage sludge to farm land. Same as above for sewage sludge treated to US EPA and LDEQ standards. (solid)
Dear Panelist:

Thanks for responding to my request for ratings of environmental topics for inclusion in our environmental education programs for farmers. I have calculated an average value of the panelists ratings for each topic and included them under the heading “First Ratings-Panels” on the enclosed list. I have also included your first rating for reference.

Please take a look at the average value of the panel’s first rating and your first rating for each topic. If you want to change your rating, please circle the number, from 1 to 7, which indicates the importance you would now place on the topic for inclusion in our environmental education program for farmers. A “1” indicates the topic is not important and a higher number indicates greater importance, with a “7” indicating a very important environmental education topic for farmers. If you do not want to change your rating on any item, just leave it blank.

I have also included additional topics suggested by various panelists. In a few cases, I edited them slightly to save space on the list. Please assign a rating of 1 to 7 to each topic indicating its relative importance.

I will calculate a final average rating value for each topic and report them to you as listed, in rank order, and with the additional topics added to the original list, by media. I would also like to report the average years of service of the panelists. I would appreciate your adding the number of years you have served in this or similar positions related to any of the environmental topics listed to the bottom of the second page next to your name.

Please return the completed rating lists to me by mail at: Bill Branch, 212 Macon Ridge Road, Winnsboro, LA, 71295-5719, or by fax at 318/435-2902. If you have any questions, my telephone number is 318/435-2908 and my email address is bbranch@agctr.lsu.edu.

Again, thanks for your help.

Sincerely,

Bill Branch
Specialist (Environmental Education)

Enclosure

202

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
<table>
<thead>
<tr>
<th>Category</th>
<th>Topic</th>
<th>First Ratings</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drinking Wtr</strong></td>
<td>private water well protection</td>
<td>6.27</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>public water supply protection</td>
<td>5.59</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Nonpoint</strong></td>
<td>soil erosion</td>
<td>5.49</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>nutrients</td>
<td>5.78</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>pesticides</td>
<td>5.78</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>animal waste</td>
<td>5.78</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>oil, grease, solvents</td>
<td>4.76</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>household sewage</td>
<td>5.41</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>irrigation return flows</td>
<td>4.46</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>micro-organisms</td>
<td>4.54</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>carcass management</td>
<td>4.84</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Point-Source</strong></td>
<td>animal waste lagoon</td>
<td>5.62</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Ground water</strong></td>
<td>animal waste storage (non-lagoons)</td>
<td>5.32</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>leaking, underground storage tanks</td>
<td>5.41</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>buried waste</td>
<td>4.97</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>inadequate backflow protection</td>
<td>5.24</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>salinity</td>
<td>3.76</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>sodium</td>
<td>3.73</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Smoke</strong></td>
<td>cane burning</td>
<td>4.58</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>forest burning</td>
<td>4.44</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>crop stubble burning</td>
<td>4.47</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>household trash burning</td>
<td>4.03</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Dust</strong></td>
<td>field plowing</td>
<td>3.43</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>livestock operations</td>
<td>3.43</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Odor</strong></td>
<td>livestock housing</td>
<td>4.29</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>livestock waste</td>
<td>4.97</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>livestock waste lagoons</td>
<td>5.11</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>carcass management</td>
<td>4.80</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Pesticide</strong></td>
<td>drift</td>
<td>5.69</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Aerial dep</strong></td>
<td>mercury</td>
<td>4.60</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>nitrogen</td>
<td>4.37</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>used engine oil</td>
<td>4.89</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>other used lubricants</td>
<td>4.72</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>old tires</td>
<td>4.50</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>empty pesticide containers</td>
<td>5.44</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>used plastic irrigation pipe</td>
<td>3.58</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>used poly or other plastic film</td>
<td>3.64</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>out of date pesticides</td>
<td>5.25</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>contaminated fuel</td>
<td>4.72</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>crop residue</td>
<td>4.14</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>carcasses</td>
<td>4.44</td>
<td>1—2—3—4—5—6—7</td>
</tr>
</tbody>
</table>

203

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
<table>
<thead>
<tr>
<th>Category</th>
<th>Topic</th>
<th>First Ratings</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Media</td>
<td>sustainable agriculture</td>
<td>5.54</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>sustainable communities</td>
<td>4.91</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>bio-diversity</td>
<td>5.09</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>endangered species</td>
<td>4.46</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>wildlife habitat</td>
<td>5.09</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>declining aquifers</td>
<td>5.78</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>increasing soil salinity</td>
<td>4.46</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>coastal erosion</td>
<td>4.95</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>rising sea level</td>
<td>4.00</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>energy conservation</td>
<td>4.94</td>
<td>1—2—3—4—5—6—7</td>
</tr>
<tr>
<td></td>
<td>water conservation</td>
<td>5.80</td>
<td>1—2—3—4—5—6—7</td>
</tr>
</tbody>
</table>

**Additional Topics Suggested by Panel:**

- Regulations affecting agriculture
- Cost-share programs for conservation measures
- Technical/educational assistance available
- Impacts of cultural practices on water quality
- Management of grazing lands
- Management of small forest land tracts
- Livestock health practices
- Livestock/forest product marketing
- Population growth
- Urbanization of rural land
- Irrigation
- Land leveling
- Conservation buffers/filter strips
- Conservation tillage (crop residue)
- Fish habitat
- Food crops
- Dog kennels
- Conservation of riparian zones
- Buffer zones
- Retention of crop residue/no-till farming
- Hold rice irrigation water for sedimentation before release
- Application of aquacultural processing waste to farm land
- Application of silvicultural processing waste to farm land
- Application of agricultural processing waste to farm land
- Application of treated sewage sludge to farm land

**Comments**

<table>
<thead>
<tr>
<th>Name of Respondent</th>
<th>Years of Service</th>
</tr>
</thead>
</table>

204

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
APPENDIX E: ACRONYMS
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARS</td>
<td>Agricultural Research Service, USDA</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>BH&amp;G</td>
<td>Better Homes and Gardens</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>CES</td>
<td>Cooperative Extension Service (state organization)</td>
</tr>
<tr>
<td>CSREES</td>
<td>Cooperative State Research, Education and Extension Service, USDA</td>
</tr>
<tr>
<td>EETAP</td>
<td>Environmental Education and Training Partnership</td>
</tr>
<tr>
<td>ERS</td>
<td>Economic Research Service, USDA</td>
</tr>
<tr>
<td>ES</td>
<td>Extension Service, USDA</td>
</tr>
<tr>
<td>Farm<em>A</em>Syst</td>
<td>Farmstead Assessment System</td>
</tr>
<tr>
<td>FSA</td>
<td>Farm Service Agency, USDA</td>
</tr>
<tr>
<td>Home<em>A</em>Syst</td>
<td>Home Assessment System</td>
</tr>
<tr>
<td>LCES</td>
<td>Louisiana Cooperative Extension Service</td>
</tr>
<tr>
<td>LDAF</td>
<td>Louisiana Department of Agriculture and Forestry</td>
</tr>
<tr>
<td>LDCRT</td>
<td>Louisiana Department of Culture, Recreation and Tourism</td>
</tr>
<tr>
<td>LDEQ</td>
<td>Louisiana Department of Environmental Quality</td>
</tr>
<tr>
<td>LDHH</td>
<td>Louisiana Department of Health and Hospitals</td>
</tr>
<tr>
<td>LDNR</td>
<td>Louisiana Department of Natural Resources</td>
</tr>
<tr>
<td>LDOTD</td>
<td>Louisiana Department of Transportation and Development</td>
</tr>
<tr>
<td>LDWF</td>
<td>Louisiana Department of Wildlife and Fisheries</td>
</tr>
<tr>
<td>LEAP</td>
<td>Louisiana Environmental Action Plan</td>
</tr>
<tr>
<td>LEEA</td>
<td>Louisiana Environmental Educators Association</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>LFA</td>
<td>Louisiana Forestry Association</td>
</tr>
<tr>
<td>LFBF</td>
<td>Louisiana Farm Bureau Federation</td>
</tr>
<tr>
<td>LPBF</td>
<td>Lake Pontchartrain Basin Foundation</td>
</tr>
<tr>
<td>LSU</td>
<td>Louisiana State University and Agricultural and Mechanical College</td>
</tr>
<tr>
<td>NAAEE</td>
<td>North American Association for Environmental Education</td>
</tr>
<tr>
<td>NCEET</td>
<td>National Consortium for Environmental Education and Training</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Service, USDA</td>
</tr>
<tr>
<td>PLT</td>
<td>Project Learning Tree</td>
</tr>
<tr>
<td>Region 6</td>
<td>USEPA (Arkansas, Louisiana, New Mexico, Oklahoma, Texas)</td>
</tr>
<tr>
<td>SCS</td>
<td>Soil Conservation Service, USDA</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>USACOE</td>
<td>United States Army Corps of Engineers</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
<tr>
<td>USDI</td>
<td>United States Department of the Interior</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
</tbody>
</table>
John William Branch was born in Brownsville, Tennessee, lived on a series of small farms, and studied Vocational Agriculture at Dyersburg High School. He enrolled in Agricultural Engineering at the University of Tennessee at Martin and worked for the USDA Soil Conservation Service on watershed design and construction projects.

He graduated from the University of Tennessee at Knoxville with a Bachelor of Science degree in Agricultural Engineering. He served on active duty with the U. S. Army in West Germany where he married Patricia Ann Craig.

He entered graduate school at the University of Tennessee at Knoxville, where he received the Master of Science degree in Agricultural Engineering with a minor in Sanitary Engineering. His research was in animal waste management.

He worked for Caterpillar Tractor Company, in Peoria, Illinois. He taught power and machinery, surveying, waste management and structures in the Agricultural Engineering Department at California State Polytechnic College, in Pomona, California. He consulted in land development, equipment testing, and dairy waste management in Southern California.

He worked as manager of farm services for Superior Farming Company near Bakersfield, California, and taught statistics at, and received the Master of Business Administration degree from, California State College, at Bakersfield.

He worked for the Louisiana Cooperative Extension Service as a specialist responsible for structures and environment, then served as Project Leader for the Environmental Education Project, and presently serves as a specialist responsible for irrigation, drainage, water quality and water management districts.
Candidate: John William Branch

Major Field: Vocational Education

Title of Dissertation: Environmental Education Programming for the Louisiana Cooperative Extension Service

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signature]

[Signature]

[Signature]

Date of Examination: 3/28/00