A definition and the concepts of agricultural literacy: a national study

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A definition and the concepts of agricultural literacy: A national study

Frick, Martin Joseph, Ph.D.
Iowa State University, 1990

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A definition and the concepts of agricultural literacy:
A national study

by

Martin Joseph Frick

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For the Graduate College
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Ames, Iowa
1990

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CHAPTER I. INTRODUCTION

Since World War I, American society has changed from a mostly agrarian perspective to a contingency of urban dwellers. Ninety percent of the population has been nonfarm for over 30 years (12). Through this change, agriculture has been the resource base that sustained our society while making a significant contribution to our national economy.

Advancements in agriculture have freed great numbers of people from farm labor to pursue a variety of careers and hastened the urbanization of our civilization. Today, with our abundant food supply and huge agricultural industry complex, most people do not understand America's food system or its impact on society and the world. Due to this situation, the public does not understand the mission or importance of publicly supported institutions such as the cooperative extension service, colleges of agriculture and U.S.D.A. research centers. Thompson (44, p. 1) stated, "If even well-informed citizens remain ignorant of basic facts about food, agriculture and natural resource systems, the activities of agricultural colleges will increasingly be perceived as serving only the interests of a narrow (and dwindling) constituency."

The current and potential effect of these developments on society is serious; today's and tomorrow's leaders of our society know far less about the real significance of agriculture upon our society.

Our nation lacks people who can look at the problems of agriculture as a whole and competently propose a course of action to solve these problems from which our society will benefit. Only through effective
educational strategies can we improve the "agricultural literacy" of individuals so they may sufficiently look at agricultural issues in the context of society's broad goals. Mayer and Mayer (29, p. 34) contend that "the failure of our secondary schools and liberal arts colleges to teach even rudimentary courses on agriculture means that an enormous majority, even among well-educated Americans, are totally ignorant of an area of knowledge basic to their daily style of life, to their family economics, and indeed to their survival." The problem of an "agriculturally illiterate" society is languid and undramatic compared with other topics that summon our attention such as the Middle East Conflict, nuclear war, and our national deficit. However, there are few topics that are of more importance to the world than adequate food supplies, proper food use, and knowledge about the components of the agricultural industry.

From these sobering facts, the term agricultural literacy was conceived. It is an expression used generously by advocates of a society where agricultural knowledge acquired by every individual is needed. Knowledge is needed to make competent decisions and to understand the decisions of others that affect the capacity and quality of America's food and fiber system. Although the phrase agricultural literacy is used frequently, the substantive nature of the term has not been determined.

To date, two definitions exist which attempt to qualify what every agriculturally literate person should know about agriculture. Gordon Douglass (12, p. 18), editor of Cultivating Agriculture Literacy, stated that agricultural literacy should include "... a description of the
place of agriculture in human history; a philosophical investigation of
the purposes of agriculture, with some attention to ethical
considerations; and an examination of the links between nutrition and
human development from the perspective of social science. It also
includes a basic introduction to the biochemistry of agroecosystems; a
comparative analysis of agricultural technologies, including an
assessment of their impacts on ecological and social communities; and a
basic treatment of the demographic transition from higher to lower rates
of population growth and the roles that the consumption and production of
food play in that transition." The second definition of agricultural
literacy was found in the newly released publication entitled
Understanding Agriculture - New Directions for Education (45). This
publication is based on the findings of the Committee on Agricultural
Education in Secondary Schools established by the National Research
Council at the request of the U.S. Secretaries of Agriculture and
Education. The Committee envisions that "an agriculturally literate
person's understanding of the food and fiber system would include its
history and its current economic, social, and environmental significance
to all Americans." This Committee further stated that "this definition
is purposely broad and encompasses some knowledge of food and fiber
production, processing, and domestic and international marketing." They
contended that "agriculturally literate people would have the practical
knowledge needed to care for their outdoor environments, which include
lawns, gardens, recreational areas, and parks" (45, p. 9).

These definitions help provide a rudimentary conceptualization of
agricultural literacy. If educational initiatives concerning the improvement of America's agricultural literacy are to succeed, standards and aspects of agriculture that fit under this concept need to be determined.

The purpose of this investigation was to develop a consensus document that could provide educators with the essential concepts about agriculture that every citizen should know. Specific objectives were to:

1. Refine a group definition of agricultural literacy;
2. Identify those subject areas that fall within the framework of agricultural literacy;
3. Identify those concepts about agriculture that every citizen should know.

The following words are defined to assist the reader in comprehending this document:

1. **subject area** - educational disciplines that are either related to or are a part of agriculture.
2. **concept** - a general idea or notion about agriculture.
CHAPTER II. REVIEW OF LITERATURE

An exploration of related literature will begin this literature review. Research related to agricultural literacy, the Delphi technique, and content analysis will also be discussed.

Related Literature

The concept of agricultural literacy has gained considerable attention within the agricultural education discipline because of the 1988 National Academy of Sciences (NAS) report entitled Understanding Agriculture - New Directions for Education (45). This report was compiled by the "Committee on Agricultural Education in Secondary Schools," which was established by the National Research Council at the request of the U.S. Secretaries of Agriculture and Education. The report outlined agricultural education's potential for developing programs to improve the nation's agricultural literacy level and made suggestions on how to implement such programs.

Based on the study's findings, the committee extended the definition of agricultural education beyond traditional vocational programs to include education about agriculture. The committee felt that "agriculture was too important a topic to be taught to only the relatively small percentage of students considering careers in agriculture and pursuing vocational agriculture studies" (45, p. v). The committee contended that achieving the goal of agricultural literacy would produce informed citizens able to participate in establishing the policies that would support a competitive agricultural industry in this
country and abroad. Principal conclusions and recommendations of the report regarding agricultural literacy were as follows (45, p. 2):

1) The focus of agricultural education must change.

   -- This conclusion is a reflection of the reality within agriculture and of changes within society. Agricultural education is more than vocational agriculture.

2) Beginning in kindergarten and continuing through twelfth grade, all students should receive some systematic instruction about agriculture.

   -- Much of this instruction could be incorporated into existing courses rather than taught in separate classes.

Regarding education in and about agriculture, the executive summary proposed that colleges of agriculture at land grant universities become more involved in curriculum reform, the development of instructional materials, and the development of media promoting agriculture. The committee recommended that "the subject matter of instruction about agriculture and instruction in agriculture be broadened" (45, p. 6).

Specifically, the reported asserted that "an agriculturally literate person's understanding of the food and fiber system would include its history and its current economic, social, and environmental significance to all Americans" (45, p. 8). It also recommended that the definition of agricultural literacy be interpreted in broad terms and include knowledge of human nutrition; outdoor environments, such as lawns, gardens, recreational areas, and parks; food and fiber production and processing; and domestic and international marketing (45, p. 9).

The NAS study received considerable national publicity. Anthan summarized the needs outlined there by asking (1, p. 1j):
So, what does our highly urban population really know about production of the commodities that are necessary for life? The answer is: "Nil."

The lack of education about agriculture and the implications of this lack had been noted years before the NAS study was released. Mayer and Mayer contended (29, p. 84):

The failure of our secondary schools and liberal arts colleges to teach even rudimentary courses on agriculture means that an enormous majority, even among well-educated Americans, are totally ignorant of an area of knowledge basic to their daily style of life, to their family economics, and indeed to their survival.

Little (28) stressed the importance of making agriculture courses mandatory for students at the high school and college levels. He believed that agriculture, like physics, zoology, and geology, is worthy of study for its own sake as a science. He further stated that (28, p. 146):

The reason the agriculture industry has no interpretive information ... to speak of is that the public does not know how to ask for it. We do not know the terms of agriculture, the language, or the basic concepts.

Kahler, addressing the relationship of agriculture to contemporary life, stated (24, p. 7):

It is also necessary for those within the industry and other members of society to understand and appreciate the importance of agricultural interrelationships in their world.

Prior to the release of the NAS report, agricultural educators had addressed agricultural education's role in improving the agricultural literacy of Americans. In 1987, Warmbrod (46) wrote that a mood seems to be developing that reform of vocational agriculture in secondary schools is warranted, if not overdue. He believed that for agricultural
education to be a viable element in public education of the future, changes in purpose, clientele, curriculum, and policy for vocational agriculture must occur. He asserted that the only way for such changes to occur would be if education in and about agriculture became a function of the total school system.

Moore (32) proposed that the emphasis must shift from vocational education in agriculture to agricultural education for all students, broadly conceived and permeating the entire elementary and secondary school years. In his estimation, agricultural education could become a unifying theme for much of the school (K through 12) curriculum. An important part of his proposal included first-hand experiences for students in as many agricultural areas as possible. He believed that implementing agricultural education in this fashion would help students in the transition from home to adult life in our society.

Since the release of the NAS report, agricultural educators have responded to its findings and proposed changes regarding implementation of the committee's recommendations. Herring, reacting to this report, presented specific philosophical questions for the discipline to resolve regarding education about agriculture (20, p. 7):

Should the clientele served by agricultural education be broadened to include all students in the public schools who would receive general education about agriculture so that all students have a basic understanding of agriculture?

Should curriculum materials for agricultural literacy programs be developed by curriculum specialists in agricultural education?

Should federal and state guidelines for administering agricultural education programs be broadened to accommodate
programs designed to teach all students about agriculture (agricultural literacy)?

Regarding Herring's last question, Frick contended that (16, p. 14):

The virtues of a vocational agriculture have been suppressed because of the demand for vocational training in agriculture outlined in the Smith-Hughes legislation in 1917.

Kahler, responding to the debate on agricultural literacy education, stated (25, p. 11):

The profession can choose to . . . provide instruction about agriculture—developing an understanding of the importance and contributions of agriculture on the part of all students and society, . . . , teaching agriculture as a basic and applied science, and establishing instruction about agriculture as a legitimate, indispensable part of the public school.

The theme of the May, 1989 issue of the Agricultural Education Magazine focused on the response of the agricultural education profession to the NAS report. According to Zurbrick, "This issue of 'The Magazine' provides a vision of agricultural education for the future" (48, p. 4). He noted that the model (Figure 1) illustrated on the cover of the magazine provided for two delivery systems each with unique characteristics that provide instruction: about agriculture and in agriculture as recommended in the National Research Council report.

Moore (31) suggested that the recommended curricular changes for agricultural education in Understanding Agriculture are a natural evolution and should not be feared. Cox et al. (8) described this "evolution" as one from "vocational education in agriculture" to "agricultural education."

Types of delivery systems to be used with agricultural literacy have been discussed within the profession. Stewart mentioned two delivery
Figure 1. Proposed model for agricultural education
systems discussed in the NAS study (42, pp. 45-46):

The Food for America program coordinated by the FFA and Agriculture in the Classroom supported by the USDA. Both efforts have been targeted at elementary students. . . . One alternative is to develop a new system of delivery. I believe, however, that the most likely approach for success lies in working to modify the existing structure. The challenge is to design a strategy that will cause existing programs to be modified to include specific agricultural content.

Cox et al. (8) also proposed a delivery system for "education about agriculture" programs in secondary schools. They contended that such a delivery system should include three components (Figure 2): (1) Agricultural science instruction, (2) supervised agricultural experience, and (3) leadership development. They projected that curriculum content would place a premium on science, biotechnology, and computer application of business management (free enterprise).

Proposed curriculum changes have caused others to consider modifications in college requirements for new teachers of agricultural education. According to Newcomb, agricultural educators would need to master a subject with an entirely new focus (35, pp. 63-64):

The new modern agriculture teacher cannot perform adequately with the usual array of technical agriculture courses. . . . More focus is needed on science principles, both outside the College of Agriculture, as well as within the college.

Addressing the development and promotion of agricultural literacy programs by state leaders in agricultural education, Stewart stressed the difficulty of developing a working definition of agricultural literacy. He stated that (42, p. 2):

What does the term, agricultural literacy, mean to you? The Committee on Agricultural Education (1988) provided two
Figure 2. Components of an agricultural science (literacy) program
definitions. The first was found in the Preface and consumed 13 lines. A shorter version was found in Chapter I.

Russell, Miller, and McCracken echoed Stewart's concern when they stated that (38, p. 2):

But, what does it really mean to be agriculturally literate? How much of what information is needed to achieve agricultural literacy?

Douglass was among the few who, before the NAS report, attempted to define agricultural literacy. He believed the term comprised the following basic elements (12, p. 18):

A description of the place of agriculture in human history; a philosophical investigation of the purposes of agriculture, with some attention to ethical considerations; and an examination of links between nutrition and human development from the perspective of social science. It also includes a basic introduction to the biochemistry of agroecosystems; a comparative analysis of agricultural technologies, including an assessment of their impacts on ecological and social communities; a description of the institutions of political and economic power that shape agricultural decisions in different societies; and a basic treatment of the demographic transition from higher to lower population growth and the roles that the consumption and production of food play in that transition.

In another attempt to define agricultural literacy, a survey was distributed to the faculty of the College of Agriculture at Texas A & M University. The survey requested faculty to submit up to five discipline-specific topics that they believed necessary for agricultural literacy. Regarding the results of the survey, Thompson (44) noted that the topics were sometimes specific, sometimes general, but interrelated as a group. The areas covered represented, broadly, economics, natural resources, ecology, biology, and nutrition.

Regarding the NAS committee's proposal that all students receive
systematic instruction about agriculture, Stewart suggested (42, p. 1):

We think more broadly and target K through adult populations as the audience for agricultural literacy.

Schreck echoed that contention when he proposed that (39, p. 34):

—expansion of agricultural education philosophy to include education in and about agriculture, K-adult . . .

Other segments of agricultural education have reacted to the NAS recommendations. The National Council for Vocational and Technical Education in Agriculture (The Council) agreed with the NAS study stating that (45, p. 1):

The Council endorses the concept of and need for agricultural literacy in grades kindergarten through twelve . . . The Council encourages state leaders to develop frameworks for state programs of agricultural literacy to parallel existing programs of vocational education in agriculture.

The National Vocational Agriculture Teachers' Association (NVATA) has provided a plan of action regarding agricultural literacy. Stenzel, the NVATA executive secretary, wrote that (41, p. 37):

We (NVATA) are endeavoring to make widespread use of "agricultural literacy" classroom materials and instruction available through partnerships with both the U.S. Department of Education and Agriculture, agricultural organizations, agribusiness industries and others with agriculturally related interests . . . not with new programs, but by infusing of agricultural education into the classroom instruction from K-12.

Before the NAS study, the USDA had been involved in a project to promote agricultural literacy. The "Agriculture in the Classroom" program was created in 1981 by Secretary John Block, through the USDA. The program was established because fewer children had direct association with agriculture, and consequently fewer understood agriculture's many
facets. Block noted the disadvantages that this spelled for the Nation's legislators (33, p. 3):

When I became Secretary of Agriculture, one of the things I realized early on was the need to educate the nation's young people on the value of agriculture. . . . We are not interested in making farmers out of everyone or getting everyone back to the farm. We simply want a nation of people who understand the importance of agriculture—who appreciate the impact that its food, fiber and forestry have on their lives. . . . More and more, agricultural policy decisions run the risk of being shaped by people who—although they are concerned about agriculture and food issues—do not have the information or background to fully understand them. . . .

Through the "Agriculture in the Classroom" program, the USDA sponsored the development of learning materials to be used by elementary teachers across the nation. Materials included the **Curriculum Framework for Teaching about American Agriculture**, the **Resource Guide to Educational Materials about Agriculture** and the **State Action Plan for Agriculture in the Classroom**. The USDA has sent out more than 350,000 publications to schools.

Social-action groups have also recognized the importance of agriculture in our society and the need to increase our nation's agricultural literacy. The League of Women Voters and the Public Voice for Food and Health Policy cooperated in the three-year "Food Forum Education Project" funded by the W. K. Kellogg Foundation of Battle Creek, Michigan. The president of the Iowa League of Women Voters, Jean Meyer (10), remarked that few had considered what a social issue agriculture could be and how it ends up affecting everybody.

Throughout the three-year project, the League of Women Voters and the Public Voice for Food and Health Policy sponsored the following
projects: An annual Food Forum designed to explore specific policy options on a selected topic; a subsequent comprehensive citizen-education campaign; and leadership-training sessions and materials on the Food Forum topics (17).

Although no program has been established to improve agricultural literacy at the high school level, a program to increase agricultural literacy has been established in a college setting. Starting in 1984, the W. K. Kellogg Foundation funded the development of agricultural literacy programs at various colleges in the United States. Generally, these programs have involved the incorporation of relevant agricultural topics into existing liberal arts courses. A few universities did design separate "agricultural awareness" courses that addressed general agricultural concerns and principles. Many agricultural topics were addressed by this program, and a new publication entitled Agriculture and Human Values was established under the auspices of the University of Florida.

The second issue of this publication was entitled "Agricultural Literacy and the Liberal Arts Curriculum." Authors of this issue suggested methods of incorporating agricultural topics into liberal arts disciplines at the university level. Haynes, the publication's editor, made the following contentions (18, p. 1):

Thinking about long-term goals for agriculture should be done by a better informed public and not simply by specialists. . . . Specialization and concentration has so fractionalized our understanding of the social contexts of agriculture that even more educated "leaders and future leaders" of our society can be described as largely ILLITERATE about the ABCs of agriculture.
The program at the University of Florida also emphasized the importance of agriculture in literature. A two-volume document about agriculture's influence on serious literature was prepared by the Department of English at the University of Florida (2). The two volumes consist of a wide range of literature related to agriculture. The volumes are divided into pre-1900 literature and post-1900 literature. This anthology was an attempt to bring together the thoughts or assumptions about agriculture of a large number of authors. Evaluations of this program were based on opinion surveys.

The Liberal Arts curriculum at Kansas State University was modified in several ways to increase the agricultural awareness of students (30). A special team-taught interdisciplinary course was introduced to explore various agricultural and agrarian issues and problems. During 1986-87, seven modified courses were taught with a combined enrollment of 1,247 students. A speaker's series was organized to deliver and discuss agricultural topics of concern to the general public. Evaluations were conducted by students and faculty in the form of opinion surveys. An outside evaluator provided a personal evaluation of the total program.

An "Agriculture and Human Values Forum" was developed by the agriculture and humanities faculties at Washington State University (21). The seminar involved a keynote speaker and seminar topics included:

1) Agriculture and the consumer,
2) Agriculture and rural society,
3) Agriculture and government policy,
4) Agriculture and food production,
5) Agriculture and education,
6) Agriculture and ecology.

Evaluation of this program was conducted by a committee of faculty members.

Texas A & M University focused its efforts on agricultural literacy by utilizing the faculty of their philosophy department (44). The philosophy department coordinated efforts between college disciplines in order to infuse agricultural literacy throughout the liberal arts curriculum. Again, a student opinion survey served as the basis for evaluation. In particular, this survey attempted to assess the opinions of students toward agriculture.

A "Consortium on Agriculture and World Hunger" was organized by four colleges in Iowa (34). The philosophy of the consortium was to make awareness of farming and the world's food needs a part of what liberally educated students take with them from their formal studies into their lives and careers. Their philosophy was implemented through seminars and the incorporation of agricultural knowledge into existing liberal arts courses. During the summer, faculty seminars were used as a means of evaluation. This consisted of instructors' reactions to the past year's activities.

The purpose of the Pennsylvania State University program was to create an increased awareness of agriculture and agricultural issues among humanists (4). Evaluation of the project was conducted by faculty and consisted of assessing whether the goals of the project had been achieved and whether the achievement of those goals had resulted in
worthwhile and lasting outcomes.

Iowa State University's (ISU) program was administered cooperatively by the Colleges of Agriculture and Sciences and Humanities (47). The goals of the program were threefold: (1) a series of workshops designed to acquaint the faculties of current issues in agriculture; (2) a program to promote and support visits of college class groups to the Living History Farms; and (3) a Speaker's Bureau in which ISU faculty members presented seminars on agricultural topics. Evaluation included input by faculty participants during a summer seminar.

The Food, Environment, Agriculture, and Society in Transition (FEAST) program was established by the University of Kentucky in order to foster greater understanding of our food and agricultural system (26). The program promoted basic sensitivity to and familiarity with food and agricultural issues among a broad base of faculty and students. New courses, films, and speakers were used to accomplish program goals. No evaluation procedure was conducted.

The cumulative results of program evaluations performed at various colleges have been very positive. According to program opinion surveys, both faculty and students have benefited from participating in the program.

Very little literature related to the topic of agricultural literacy was found outside the auspices of the W. K. Kellogg Foundation project and agricultural education.
Related Research

The preceding section has documented the novelty of agricultural literacy. Thorough manual and computer-aided literature searches provided little evidence of scientific research related to agricultural literacy. In fact, this search found only one research effort that had been conducted to assess students' knowledge of agriculture. This study was conducted in cooperation with the Kansas Foundation for Agriculture in the Classroom (KFAC) and the Kansas State University's College of Education. Horn and Vining, discussing the KFAC study, stated that (22, p. 6):

The purpose of this study was to assess students' knowledge of agriculture related to six major concepts identified by the Kansas Foundation for Agriculture in the Classroom (KFAC) and incorporated into the curriculum guide entitled Integrating Agriculture in the Classroom. These concepts are listed below.

- **Concept 1** Agriculture is the business that provides our food, clothing and shelter.
- **Concept 2** Agriculture is interdependent with the well-being of society in Kansas, the United States and the world.
- **Concept 3** Agriculture is a vital dynamic system shaped by research and development.
- **Concept 4** Agriculture is influenced by government.
- **Concept 5** Agriculture is interdependent with the environment and uses natural resources.
- **Concept 6** Agriculture is historically significant.

Over 2000 students, distributed throughout Kansas and across three school levels, were subjects in the study. Horn and Vining summarized their discussion of the study as follows (22, p. 112):

The level of knowledge about agriculture, as assessed by this study, is quite low. Without specific attention being directed to this area, little improvement can be expected... The question may reside in what is an acceptable level of knowledge, but these researchers do not believe the knowledge level exhibited by the respondents in this study is
satisfactory. It is recommended that these results be used to guide further curriculum development and to implement concepts from all aspects of the agricultural industry into the mainstream curriculum of K-12 schools.

Besides the KFAC study, other relevant research efforts have been found. Jordan and Tweeten (23) conducted a nationwide survey entitled "Public Perceptions of Farm Problems." The objective of the study was to ascertain the U.S. public's understanding of farm policy and perceptions of the farm situation. In summarizing the results of the survey, Jordan and Tweeten stated that (23, p. 8):

"It is important to recognize that respondents merely gave their reaction to questions posed. Responses might have been different to some of the questions if an educational program had preceded the questionnaire."

Literature was reviewed in an attempt to locate a method for developing a consensus definition of agricultural literacy. The procedure known as content analysis was chosen to achieve this goal. Content analysis is a widely used technique that has a multitude of applications. According to Lindkvist (27), content analysis is principally a technique for quantitative analysis of extensive texts within the framework of a communication model. Berleson (3) stated that the method of content analysis has been applied to so large and diverse a group of materials, with respect to so large and diverse a set of problems, that it is not easy to order the uses in a single classification.

An investigation into the development and uses of the Delphi technique provided the justification for using this technique as the main method of inquiry in this study. The Delphi technique was developed by
the Rand Corporation (6) during the 1950s and 1960s. The technique was originally used as a method of eliciting and refining group judgments. It replaces direct confrontation and debate by submitting an expert panel to an orderly program of sequential individual interrogations in the form of questionnaires. It was originally applied to form consensus about defense problems and estimating future dates of social and technological advances. Dalkey described the Delphi process in this way (9, p. 16):

In general, the Delphi procedures have three features: (1) anonymity, (2) controlled feedback, and (3) statistical group response. . . . The procedure is, above all, a rapid and relatively efficient way to "cream the tops of the heads" of a group of knowledgeable people.

The Delphi technique has been used to solicit expert opinion when a knowledge base upon which decisions can be made is absent. Variants of the Delphi can be applied to all phases of educational planning, including curriculum reform (19, p. 6).

Regarding use of the Delphi in determining curriculum content, Finch and Crunkilton noted that (14, p. 132):

Obviously, this technique would be of much value when persons desire to reach consensus regarding the content of a particular curriculum. All too often there is more content available than time in which to teach the material. The curriculum developer must provide a means for ensuring that the most relevant content is included and the least relevant content is excluded.

A major strength of the technique is the more flexible time parameter that individuals have for responding at their convenience. On the other hand, a time commitment from experts is necessary for completion of the Delphi process. Costs of conducting a Delphi are minimal, with mailing being the primary expense (5).
One methodological study that used the Delphi technique was found to be relevant to the development of an agricultural literacy instrument. The "Characteristics of Technological Literacy: Perspectives from the Industrial and Educational Sectors" was conducted to identify the characteristics of the technologically-literate generalist (15). The research strategy used was the Delphi technique. Delphi panelists submitted statements that characterized a technologically literate individual. Statements were grouped into categories. Each statement was rated by individual panelists and a mean was calculated for each statement.

The Delphi approach has also been applied to higher education curriculum development. Reeves and Jauch (37) performed a Delphi using a business advisory council to ascertain course subject areas and course hour allocations for a Midwestern university's school of business. Since business managers employed graduates of the school, the researchers believed they would serve well as experts for the study. The solicitation of business managers' advice was viewed as less traditional and introspective in comparison to the more obvious experts, the faculty. Participation in the Delphi process was disappointing. Still, the study provided the desired decisions so that curriculum changes could be implemented.

Educators have successfully applied the Delphi technique in a variety of problem-solving situations. It has been used extensively as a technique for strategic planning of educational programs. Delphi has been suggested by Pratt (36) as a means of finding priorities within a curriculum needs assessment project. Stone (43) used a modified Delphi
technique to conduct a community-based needs assessment in the West Des Moines Community School District. In acquiring planning data to meet the needs of adult part-time students in North Carolina, Fendt (13) used Delphi. Dodge and Clark (11) recommended using the Delphi technique with content experts as a means of generating objectives for some instructional materials.

Recently, Buriak and Shinn (7) used Delphi to develop consensus on the focus and direction of programmatic research efforts in agricultural education. The study was conducted in four phases and used selected deans and directors from leading land-grant research universities. These external experts responded to three fundamental questions asked by Buriak and Shinn (7, p. 11):

1.) What should be the research mission of agricultural education?
2.) What are the current and future research needs in agricultural education?
3.) What are the obstacles which limit the conduct of programmatic research in agricultural education?

Based on the literature and research reviewed in this chapter, there appears to be a broadening mission for agricultural education in the future. The NAS study has brought agricultural literacy to the forefront of issues facing agricultural education. Much discussion has centered around addressing agricultural education's role in pursuing agricultural literacy initiatives. It was the aim of this research to provide information that could be used by educators at all levels who are interested in initiating agricultural literacy in their educational setting.
CHAPTER III. METHODS AND PROCEDURES

This chapter presents the research procedures used to accomplish the objectives of the study. Specifically, the chapter will concern: (1) Research Procedures, and (2) Data Treatment.

Research Procedures

Instrument development

Three questionnaires were developed and employed in the study. The design of the first questionnaire was based on Stewart's (42) suggestion that an operational definition for agricultural literacy is needed before undertaking agricultural literacy initiatives. The design of questionnaire two was based on the consensus definition derived from the first questionnaire. Questionnaire three requested demographic information and the ranking of information from the second questionnaire.

The first questionnaire asked panelists to submit their definition of agricultural literacy. Quantitative content analysis was conducted on 78 definitions, and a consensus definition was developed. Besides providing a behavioral definition of agricultural literacy, the consensus definition identified 11 broad areas of agricultural knowledge. These areas were: (1) agriculture's important relationship with the environment; (2) processing of agriculture products; (3) public agricultural policies; (4) agriculture's important relationship with natural resources; (5) production of animal products; (6) societal significance of agriculture; (7) production of plant products; (8) economic impact of agriculture; (9) marketing of agricultural products;
distribution of agricultural products; and (11) global significance of agriculture.

The group definition of agricultural literacy accompanied the second questionnaire sent to the panelists. This questionnaire asked panelists to react to the group definition by submitting one concept for each of the eleven agricultural knowledge areas identified in the group definition. Panelists were also asked to specify under which agricultural discipline their concept should be taught. Instructions and examples of written concepts were provided.

Panelists voiced a concern that a subject area in the K through 12 curriculum was not identified for each concept. Subsequently, a letter was sent inviting all panelists to resubmit their concepts and the subject area identified if they wished. No panelists resubmitted their 11 concepts.

Each concept submitted was compiled under its broad subject area, and duplicate concepts were eliminated. Concepts under each area were then reviewed and placed in subcategories. The third questionnaire asked Delphi panelists to submit demographic information and to rank various aspects of agricultural literacy. The questionnaire was broken into three sections. The first section of the questionnaire asked panelists to provide the years of formal education they had attained, their present position in the agriculture industry, the number of years in their present position, and their gender. The second section asked panelists if they had read the NAS Report on Agricultural Education and to rank themselves regarding their expertise in agricultural literacy. In the
third section, panelists ranked the eleven broad concept areas in terms of importance to agricultural literacy, and listed the concept areas in which they felt they possessed the most knowledge.

The concepts generated were further refined by the researcher and categories of agricultural literacy concepts developed. A summary was also prepared that explained the preparation of the questionnaires. A copy of the cover letters, summary, and questionnaires appear in Appendix B.

Selection of Delphi panel

After reviewing the literature and related research, on March 22, 1989, a letter requesting a minimum of three nominees to the Delphi panel was sent to faculty members at land-grant university agricultural education departments. The agricultural education departments that responded to that request are listed in Table 1. Table 2 presents the agricultural education departments that did not submit panel nominees. The letter asked that nominees possess an interest in agricultural literacy, have the time, in the nominator's estimation, to devote to the study, and not be faculty members of any agricultural education department. The total number of individuals nominated by 48 agricultural education faculty members was 147. On May 12, 1989, a letter was sent to the Delphi nominees requesting their participation in the study. Of the 147 nominated, 100 initially agreed to participate in the study. From the initial 100 panelists, two asked to be removed from the panel because of other commitments, 78 submitted definitions, and 58 submitted
Table 1. Land grant university (1862) agricultural education departments that nominated panelists

<table>
<thead>
<tr>
<th>State</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Missouri</td>
</tr>
<tr>
<td>Alaska</td>
<td>Montana</td>
</tr>
<tr>
<td>Arizona</td>
<td>Nebraska</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Nevada</td>
</tr>
<tr>
<td>California</td>
<td>New Hampshire</td>
</tr>
<tr>
<td>Colorado</td>
<td>New Mexico</td>
</tr>
<tr>
<td>Connecticut</td>
<td>New York</td>
</tr>
<tr>
<td>Delaware</td>
<td>North Carolina</td>
</tr>
<tr>
<td>Florida</td>
<td>North Dakota</td>
</tr>
<tr>
<td>Georgia</td>
<td>Ohio</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Oklahoma</td>
</tr>
<tr>
<td>Idaho</td>
<td>Oregon</td>
</tr>
<tr>
<td>Illinois</td>
<td>Pennsylvania</td>
</tr>
<tr>
<td>Indiana</td>
<td>Rhode Island</td>
</tr>
<tr>
<td>Iowa</td>
<td>South Carolina</td>
</tr>
<tr>
<td>Kansas</td>
<td>South Dakota</td>
</tr>
<tr>
<td>Kentucky</td>
<td>Tennessee</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Texas</td>
</tr>
<tr>
<td>Maine</td>
<td>Utah</td>
</tr>
<tr>
<td>Maryland</td>
<td>Vermont</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>Virginia</td>
</tr>
<tr>
<td>Michigan</td>
<td>Washington</td>
</tr>
<tr>
<td>Minnesota</td>
<td>West Virginia</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Wisconsin</td>
</tr>
</tbody>
</table>

Table 2. Land grant university (1862) agricultural education departments that did not nominate panelists

<table>
<thead>
<tr>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Jersey</td>
</tr>
<tr>
<td>Wyoming</td>
</tr>
</tbody>
</table>
This investigation was a study of expert opinion. Reliability was not expressed in terms commonly observed in the profession. Dalkey (9), in extensive studies of the Delphi technique, found reliability to be a function of group size (Figure 3). When the number of participants per group was greater than thirteen, questions of process reliability were satisfactorily answered; mean correlations were greater than .80. The number of panelists involved in all phases of this study surpassed the number needed to satisfactorily answer the question of process reliability.

![Figure 3. Reliability as a function of group size; mean correlation](image)
Over 500 concepts were generated from the second questionnaire. Some panelists elected not to generate concepts in some of the 11 broad subject areas because they felt that they were not knowledgeable in those areas. A list of participants is located in Appendix E. The consensus definition and the refined concepts can be found in Chapter IV, entitled Findings.

The large number of concepts made further refinement and consensus of concepts by the panelists difficult. The researcher felt that the large number of concepts to be reviewed by panelists would inhibit participation in subsequent rounds. The researcher with the help of committee members eliminated duplicate concepts and further refined the list of concepts submitted.

Collection of data

The three questionnaires described in this chapter were used to create an operational definition of agricultural literacy, to identify the conceptual areas making up the framework of agricultural literacy, and to rank the importance of those conceptual areas. Questionnaires were printed and mailed with an appropriate cover letter to each panelist. Copies of questionnaires are located in Appendix D, while the cover letters are located in Appendix B. The group definition of agricultural literacy and the refined concepts are located in Chapter IV entitled Findings.

The questionnaire asking for a definition of agricultural literacy was mailed on June 23, 1989. A letter reminding the panelists to submit
their definition was sent on July 25, 1989. The group definition and second questionnaire were mailed on August 25, 1989. A letter reminding the panelists to submit their definition was sent on September 25, 1989. The demographic questionnaire requesting information and a ranking of various aspects of agricultural literacy were sent on November 15, 1989. Response rates for the three questionnaires were 78, 55, and 86 percent, respectively.

Data Treatment

Due to the nature of the chosen research procedures, the treatment of data involved the use of frequencies, percentages, the Wilcoxon Sum Rank test, the Mann-Whitney U test for the two-sample case, the Kruskal-Wallis one-way analysis of variance, the Dunn's Multicomparison procedure, and Spearman Rank correlation.

The statistical analysis of questionnaire one involved the calculation and reporting of frequencies of recurring text found in the 78 definitions submitted. Percentages of the frequencies were calculated. Subject area and behavioral text found in more than 25 percent of all submitted definitions was included in the consensus definition.

A statistical analysis of questionnaire two was not conducted. Concepts submitted in each of the 11 categories were subdivided to refine the concepts.

The statistical analysis of questionnaire three involved: (1) the calculation of frequencies for gender, present position, and for
familiarity with the NAS Report on Agricultural Education; (2) the calculation of a mean for the educational level of panelists—their present position, their agricultural literacy expertise, the importance of the 11 conceptual areas to agricultural literacy, and self-assessment of knowledge of the 11 conceptual areas. A Spearman-rank correlation procedure was conducted to determine the level of relationship that existed between concept area ranking and concept knowledge possessed by the panelists. A Wilcoxon Sum Rank test was used to determine if any significant differences existed between pairs of corresponding concept area importance and knowledge rankings. The sample of panelists was subdivided to conduct further statistical tests. The sample of panelists was subdivided by agricultural literacy expertise, whether they had read the NAS Report on Agricultural Education, and three major occupational categories. These subdivisions allowed the researcher to conduct the Mann-Whitney U test to determine if any differences existed between the two-sample cases on the importance of the concept area and concept knowledge possessed mean rankings. A Kruskal-Wallis test and a Dunn's Multiple Comparison procedure was conducted to determine if any differences existed between the three occupational categories on the importance of the concept areas and concept knowledge possessed rankings.
CHAPTER IV. FINDINGS

This chapter presents a summary of responses provided by the Delphi panel from three questionnaires. The data are organized under the following headings: (1) Panelists' Background Information; (2) Definition of Agricultural Literacy; (3) Agricultural Literacy Concepts; (4) Comparison of Respondents' Rankings of Concept Areas' Importance to Agricultural Literacy and Concept Knowledge Possessed; and (5) Major Findings.

Panelists' Background Information

Panelists that submitted one of the 78 agricultural literacy definitions were asked to complete the demographic questionnaire. The number of panelists that responded to the survey instrument was 67. The Western Region of the United States contained 23 percent of the panelists, 31 percent were from the Central Region, 29 percent were from the Southern Region, and 17 percent were from the Eastern Region (Figure 4). A list of panelists by state is located in Appendix C.

![Pie chart showing percentage of panelists by agricultural education region]

Figure 4. Percentage of panelists by agricultural education region
The panelists' present employment varied greatly, but all were involved in some way with agriculture. Table 3 indicates the number of participants by occupational category.

Table 3. Positions of three major occupational categories and number of panelists by position (n=67)

<table>
<thead>
<tr>
<th>Agriculture industry (n=19)</th>
<th>Elementary and secondary education (n=23)</th>
<th>Higher education (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural organizations (n=3)</td>
<td>State agricultural education staff (n=11)</td>
<td>University faculty (n=7)</td>
</tr>
<tr>
<td>Agribusiness (n=11)</td>
<td>Agriculture in the classroom coordinator (n=5)</td>
<td>University administration (n=12)</td>
</tr>
<tr>
<td>Farm Bureau (n=2)</td>
<td>Vocational agriculture instructor (n=4)</td>
<td>Extension (n=6)</td>
</tr>
<tr>
<td>Farmer (n=3)</td>
<td>High school instructor (n=1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High school administration (n=2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former vocational agriculture instructor* (n=3)</td>
<td></td>
</tr>
</tbody>
</table>

*Former vocational agriculture instructors were recognized in another position.

A category entitled "former vocational agriculture instructor" accumulated three responses from individuals who also noted their present
employment. Thirty percent of the panelists were categorized as representing the agricultural industry, 34 percent of the panelists represented elementary and secondary education, and 36 percent of the panelists fell into the category of higher education (Figure 5). Of the 67 respondents, 64 were directly employed in an agriculturally related position. The three remaining respondents were elementary or secondary teachers and administrators who were involved in "agriculture in the classroom" projects.

The panel consisted of 59 males, 7 females and one nonrespondent (Figure 6). The average level of education of the panelists was 19.05 years, and the average years of employment in their present position was 11.04 years (Figure 7).
Figure 6. Gender of panelists

Figure 7. Panelists' average level of education and years in present position
On a one-to-seven Likert scale that (7 = expert, 1 = little knowledge) measured the panelists' expertise on agricultural literacy, the average rating of panelists was 4.84, and the standard deviation was 1.04. The median ranking of five was used to group panelists into experts and nonexperts. Panelists were labeled as experts if they ranked themselves a 5 or higher and nonexperts if they ranked themselves 4 or lower. Panelists' ranking of their expertise ranged from 7 to 2. Using the preceding criteria, 43 or 64 percent of the panelists were experts, whereas 24 or 36 percent were nonexperts (Figures 7 and 8). Expert and nonexpert panelists were further sorted by occupational category (Figure 10). Experts' and nonexperts' ranking of concept areas and self-ranking of concept knowledge possessed were compared by the researcher. Procedures used and results of this comparison are described later in this chapter.

Figure 8. Number of expert and nonexpert panelists
Figure 9. Percentage of expert and nonexpert panelists

Figure 10. Number of experts and nonexperts by occupational category
Forty-five of the panelists stated that they had read the NAS Report on Agricultural Education, whereas 22 responded that they had not read the report (Figure 11). Information gathered from the demographic questionnaire was used to compare these two groups. The average expertise of the panelists reading the NAS Report was 5.16, whereas it was 4.18 for those panelists not reading the NAS Report (Figure 12). The number of panelists that had read the report and ranked themselves as experts was 34, whereas only 11 ranked themselves as nonexperts (Figure 13). The number of panelists that did not read the report and ranked themselves as experts was 9, whereas 13 ranked themselves as nonexperts.

Figure 11. Number of panelists that read the NAS Agricultural Education Report
Figure 12. Self-ranked expertise of panelists by whether they had read the NAS Agricultural Education Report

Figure 13. Expert and nonexpert panelists by whether they read the NAS Report
Definition of Agricultural Literacy

Data in Table 4 reveal the frequencies and percentages of recurring text found in 78 definitions submitted by panelists. Quantitative content analysis was performed in order to calculate frequencies and percentages of each recurring text. From Table 4, a group definition of agricultural literacy was developed.

Two behavioral terms and 11 broad agricultural subject areas were observed in over 25 percent of the 78 definitions submitted. These 13 terms were used to form the consensus definition of agricultural literacy. The 11 broad agricultural areas identified were incorporated into the second questionnaire that asked panelists to identify a concept for each of the 11 broad agricultural areas that every citizen should know.

The consensus definition was returned to panelists for their comments. Since none of the panelists made any comments regarding the consensus definition, it remained intact for the duration of the study.

The panelists' definition of agricultural literacy follows:

Agricultural literacy is understanding and possessing a knowledge of our food and fiber system. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture. Basic agricultural knowledge includes: the production of plant and animal products (divided into separate concept areas in the concept questionnaire), the economic impact of agriculture, its societal significance, agriculture's important relationship with natural resources and the environment (divided into separate concept areas in the concept questionnaire), the marketing and processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products.
Table 4. Quantitative content analysis for 78 agricultural literacy definitions

<table>
<thead>
<tr>
<th>Subject area text</th>
<th>Frequencies</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Societal significance of agriculture</td>
<td>47&lt;sup&gt;a&lt;/sup&gt;</td>
<td>60.26</td>
</tr>
<tr>
<td>Production of plant and animal product</td>
<td>46&lt;sup&gt;a&lt;/sup&gt;</td>
<td>58.97</td>
</tr>
<tr>
<td>Food and fiber system</td>
<td>40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>51.28</td>
</tr>
<tr>
<td>Economic impact of agriculture</td>
<td>35&lt;sup&gt;a&lt;/sup&gt;</td>
<td>44.87</td>
</tr>
<tr>
<td>Natural resources and the environment</td>
<td>34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>43.59</td>
</tr>
<tr>
<td>Marketing</td>
<td>29&lt;sup&gt;a&lt;/sup&gt;</td>
<td>37.18</td>
</tr>
<tr>
<td>Processing</td>
<td>28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>35.90</td>
</tr>
<tr>
<td>Public policies</td>
<td>22&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.20</td>
</tr>
<tr>
<td>Global significance</td>
<td>21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26.92</td>
</tr>
<tr>
<td>Distribution</td>
<td>20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>25.64</td>
</tr>
<tr>
<td>Communication skills</td>
<td>15</td>
<td>19.23</td>
</tr>
<tr>
<td>The science of agriculture</td>
<td>15</td>
<td>19.23</td>
</tr>
<tr>
<td>The history of agriculture</td>
<td>11</td>
<td>14.10</td>
</tr>
<tr>
<td>Nutrition and health</td>
<td>11</td>
<td>14.10</td>
</tr>
<tr>
<td>Biology</td>
<td>11</td>
<td>14.10</td>
</tr>
<tr>
<td>Agricultural management</td>
<td>10</td>
<td>12.82</td>
</tr>
<tr>
<td>Careers and occupations</td>
<td>10</td>
<td>12.82</td>
</tr>
<tr>
<td>Soil/land use</td>
<td>9</td>
<td>11.54</td>
</tr>
<tr>
<td>Technology</td>
<td>9</td>
<td>11.54</td>
</tr>
<tr>
<td>Outdoor environments</td>
<td>7</td>
<td>8.97</td>
</tr>
<tr>
<td>Food supply</td>
<td>6</td>
<td>7.69</td>
</tr>
<tr>
<td>Chemical use</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Sustainable agriculture</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Horticulture</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Research of agriculture</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Water/groundwater use</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Retailing</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Financing</td>
<td>5</td>
<td>6.41</td>
</tr>
<tr>
<td>Mechanics/engineering</td>
<td>4</td>
<td>5.13</td>
</tr>
<tr>
<td>Animal physiology</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Farming</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Forestry</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Pleasure animals</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Art of farming</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Aesthetics of agriculture</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Standard of living</td>
<td>3</td>
<td>3.85</td>
</tr>
<tr>
<td>Marine animals</td>
<td>2</td>
<td>2.56</td>
</tr>
<tr>
<td>Rural development</td>
<td>2</td>
<td>2.56</td>
</tr>
<tr>
<td>Risks of farming</td>
<td>2</td>
<td>2.56</td>
</tr>
<tr>
<td>Biotechnologies</td>
<td>2</td>
<td>2.56</td>
</tr>
<tr>
<td>Conservation practices</td>
<td>2</td>
<td>2.56</td>
</tr>
</tbody>
</table>

<sup>a</sup> Retained for formulation of group definition.
Table 4. (Continued)

<table>
<thead>
<tr>
<th>Behavioral area text</th>
<th>Frequencies</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>An understanding of agriculture</td>
<td>42^a</td>
<td>53.85</td>
</tr>
<tr>
<td>Knowledge of agriculture</td>
<td>34^a</td>
<td>43.59</td>
</tr>
<tr>
<td>Appreciation of agriculture</td>
<td>13</td>
<td>16.67</td>
</tr>
<tr>
<td>Awareness of agriculture</td>
<td>7</td>
<td>8.97</td>
</tr>
<tr>
<td>Educated about agriculture</td>
<td>4</td>
<td>5.13</td>
</tr>
<tr>
<td>Educated in agriculture</td>
<td>2</td>
<td>2.56</td>
</tr>
<tr>
<td>Ability to interpret</td>
<td>2</td>
<td>2.56</td>
</tr>
</tbody>
</table>

Agricultural Literacy Concepts

The panelists' consensus definition of agricultural literacy led to the development of questionnaire two and, subsequently, to the generation of agricultural literacy concepts. These concepts were generated for each of the 11 agricultural literacy concept areas identified in the agricultural literacy definition. A total of 590 concepts were submitted by panelists (Table 5).

The concepts were refined by the researcher. This was accomplished by identifying duplicate concepts and concepts that could be combined. Some concepts remain in more than one concept area because they are relevant to a number of concept areas. Sub-areas of the 11 agricultural literacy concept areas emerged from the raw list of panelists' concepts. The 11 agricultural literacy concept areas and their respective sub-areas are located in Table 6. The number of refined concepts for the 11 agricultural literacy concept areas is located in Table 5. The lists of refined concepts are located in Tables 7 through 17.
Table 5. The 11 agricultural literacy subject areas by the total number of generated and refined number of concepts

<table>
<thead>
<tr>
<th>Subject area</th>
<th>Number of concepts generated</th>
<th>Refined number of concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture's important relationship with the environment</td>
<td>55</td>
<td>39</td>
</tr>
<tr>
<td>The processing of agricultural products</td>
<td>51</td>
<td>31</td>
</tr>
<tr>
<td>Public agricultural policies</td>
<td>53</td>
<td>41</td>
</tr>
<tr>
<td>Agriculture's important relationship with natural resources</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td>Production of animal products</td>
<td>52</td>
<td>29</td>
</tr>
<tr>
<td>Societal significance of agriculture</td>
<td>55</td>
<td>35</td>
</tr>
<tr>
<td>Production of plant products</td>
<td>55</td>
<td>37</td>
</tr>
<tr>
<td>Economic impact of agriculture</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td>The marketing of agricultural products</td>
<td>53</td>
<td>43</td>
</tr>
<tr>
<td>The distribution of agricultural products</td>
<td>49</td>
<td>35</td>
</tr>
<tr>
<td>The global significance of agriculture</td>
<td>55</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>590</td>
<td>394</td>
</tr>
</tbody>
</table>
Table 6. The 11 agricultural literacy subject areas and their respective sub-areas

Agriculture's important relationship with the environment
- The agriculturalist's role in protecting the environment
- The effect of agriculture on the environment
- Opinions and perceptions
- Chemicals
- Positive effects of agriculture on the environment
- Negative effects of agriculture on the environment
- The environment's close relationship with agriculture

The processing of agricultural products
- Steps and complexities of processing
- Importance of processing and value added products
- Food safety
- Product development and technology

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- Conservation of natural resources
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Table 6. (Continued)

- Rural life
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Production of plant products

- Greenhouse/gardens
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The marketing of agricultural products

- Marketing plan and strategy
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- The distribution system and its importance
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- Cost of distribution
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The global significance of agriculture

- Global food economics
- Global hunger and food distribution
- Technology and university research
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Table 7. Agriculture's important relationship with the environment

The agriculturalist's role in protecting the environment

All agriculture producers have an impact on the environment as they conduct their business.

The stewardship of our environment by the agricultural industry.

Agriculture's value in becoming more involved in protecting the environment and preserving life forms.

The effect of agriculture on the environment

Agriculture can be harmful to the environment.

Interactions of agriculture and the environment are interchangeable and have economical, political, social, and ethical implications.

Agriculture establishes control over the environment to create optimum conditions for plant and animal growth.

Opinions and perspectives

The effects of agricultural production and processing procedures on the environment are long term.

Human existence on earth depends upon a hospitable environment.

Common sense, public sentiment, and acts of legislation dealing primarily with water, air, soil, pesticides, and herbicides have curtailed emission of pollutants.

Ranch and farm operators are very conscientious and concerned about the environment.

Influence of the environmental movement on agriculture.

The impact of plant and animal production on the environment.

Farmers own and control a large part of the environment.

Balancing of productivity/efficiency/food quality/risk with regard for the environment.
Table 7. (Continued)

Chemicals

Utilizing Integrated Pest Management (IPM) programs to reduce the amount of pesticides applied.

Impact of continuous use of farm chemicals on soil composition, fertility, water retention, and production capabilities.

Use of chemicals to produce food and fiber in America but still protect the public.

Use of chemicals in animal and plant production.

Plants will be bred with a natural inherent resistance to pests and disease that reduce the amount of pesticides applied and reduce the hazards to the environment.

The effect of pesticides on agriculture's current level of production.

Pollution problems due to the large use of synthetic inputs.

The economic and environmental benefit of using the integrated pest management approach.

Positive effects of agriculture on the environment

The role of plants and trees in using carbon dioxide (CO₂) to supply oxygen to our environment and clean our air.

Wastes from the animal production can be a major pollutant of the environment, but also supply a fertilizer volume of $1 billion.

Agriculture has the ability to use waste products (i.e., fish meal, sewage sludge, organic wastes) which would otherwise be difficult to dispose.

Pesticides and fertilizers help the environment by allowing farmers to practice conservation tillage methods and improve soil fertility.

Agriculture/horticulture's role in improving the environment by reducing sound and sediment pollution and improving air quality.
Table 7. (Continued)

Negative effects of agriculture on the environment

Destruction of wildlife habitat caused by agricultural irrigation runoff can be avoided.

Deterioration of water quality in rural areas is due in part to agriculture.

Modern agriculture's exploitative use of soil and water resources and its heavy reliance on chemical pesticides and fertilizers.

The need for food and cover for wildlife due to increasing human pressure on land is agriculture's responsibility.

The environment's close relationship with agriculture

Agricultural methods that can benefit the environment; i.e., renewable resources, and soil conservation.

The interrelationship of man and nature includes the benefits and risks for both parties.

Sustainable agriculture

Sustainable agriculture is economically viable and environmentally sensitive.

The production of food and fiber without destruction of the environment, while conserving renewable natural resources, is a co-dependent function and integral to agriculture in the United States.

Agriculture by its nature attempts to modify the environment.

Properly managed production agriculture exists in harmony with its environment.

Maintaining the balance of nature, while striving for even greater production—the quality of our water (above and below ground) and the carbon dioxide \( \text{CO}_2 \) balance in our atmosphere.

Re-establishment of our grasslands and woodlands helps to maintain their quality and supply over time.

Sustainable agricultural systems are necessary for our race to survive.
Table 8. The processing of agricultural products

Steps and complexities of processing

The steps involved in processing agricultural products.

The complexities and stages of taking various raw agricultural inputs and enhancing their acceptability, quality, and/or utility.

Movement of a commodity and all the by-products through all the different locations involved in all the processes.

Quality control and product integrity must be maintained throughout all processing procedures.

The economics of producing agricultural products ends with a relatively uniform retail market price.

Importance of processing and value added products

The processing industry is vital in delivering agricultural products to the ultimate consumer.

Youth needs to be aware of careers in the processing industry.

Agricultural products are transformed into usable items for consumption and/or industrial uses.

Processing agricultural products near production sites add value to basic commodities.

Value-added processes increase net income at all levels of the production, processing, and marketing chain.

In 1987, the agricultural processing sector for 19% ($86 billion) of the value added in food marketing.

Processing accounts for more than half of the retail price of many value-added agricultural products such as pastry products.

The processing function as one of the eight basic functions of any marketing process.

Food safety

The relationship of end product quality to the healthfulness of any product.
Table 8. (Continued)

Food safety is the primary concern of the food processing industry and remains important to modern-day lifestyles.

Agricultural processing must be cost efficient while ensuring product integrity.

Product development and technology

New processing technologies influence the quality, variety, and market presentation of agricultural products.

Surplus production's affect on alternate uses of traditional grain crops.

Processing can be energy intensive and nutrient destructive.

Processing adds value to farm commodities and puts them into a form that consumers can use.

The development of consumer-ready foods from raw agricultural products is demanded by consumers.

United States food processing technology provides quality food to a higher percent of its population than any other country.

Pre-cooked packaged foods have greatly aided working families.

Biotechnology offers possibilities for agricultural product diversification.

Consumers demand an abundance of wholesome agricultural products at an affordable price.

Processing and packaging increase market value of many farm commodities.

Consumer preferences have changed due to many societal factors which resulted in demands for processed products that didn't exist five years ago.

New processing methods, new products, and new target populations, coupled with strong advertisement techniques, will be necessary to maintain agricultural markets.

Depending on processing techniques, a variety of consumer products may come from one farm commodity to meet consumer demands.
Table 8. (Continued)

Containers for many agricultural products cost more than the producer receives for the raw agricultural product.

New products and new methods of product processing highlight the role of agriculture as a major force in the supply of healthful and environmentally safe food, fiber, energy, and industrial commodities.
Table 9. Public agricultural policies

Government policy impact on the industry

Assess the impact of a national agricultural policy on the agricultural industry.

Public policies often are dictated by popular sentiment and those unfamiliar with agriculture.

Effects of agricultural price support programs on commodity prices.

Government agricultural policy affects all facets of the agriculture industry and the economy.

Agricultural policy influences the political, social, and economic well-being of every citizen.

The effect public agricultural policy has had (historical), is having (current), and will have (futuristic) on the agriculture industry.

Farm programs dictate profitable production systems.

Agricultural policies influence and are influenced by global factors.

Society depends on the flow of raw materials. Policy decisions affect these essential supplies.

Government embargoes placed on agricultural commodities will stimulate other parts of the world to produce the crop affected by the embargo.

Understanding agricultural policies is important to agribusinessmen and agriculturalists.

The interdependence of agricultural system components that the government interferes with.

America has a "cheap" food policy. Most people not involved in agriculture have not realized the potential impact of removing this policy.

The unaware public/consumer

Public agricultural policies should reflect the interests of most producers and consumers of agricultural goods. The rural population
needs to be more aware of how agricultural policy is formed so they
can become involved.

Agricultural policy affects all citizens, thus involving many
additional players into the political process.

Every citizen should understand why agriculture is subsidized.

Public agricultural policies are likely to be more appropriately
formulated by an agriculturally literate group of policy makers as
well as an agriculturally literate constituency that supports the
policy makers.

Strong farm organizations must be the "voice" for the minority in
agriculture.

Thomas Jefferson's philosophy held that the strength of our nation
lies greatly in individuals owning and working their own land with
the freedom to make basic decisions about that land and what it
produces.

Decisions made off the farm by nonfarmers affect the practices and
profits of agriculture.

The government's role and limitations regarding agricultural policy

The political process is based on policies for farm production
areas, but lacks policies for the broad, integrated scope of
agriculture.

Government's role in food inspection for the public's protection.

Objective decisions regarding agricultural land use and effective
use of agricultural products are critical to agricultural policy.

Public agricultural policies need to be the result of long-term
planning with the mechanism to implement those plans.

Agricultural practices must be monitored to create a balance between
the concerns of production efficiency, environmental protection,
supply and demand, and product quality.

Policies regarding agricultural production affect worldwide food and
fiber systems.
The USDA assists farmers and citizens with government funds to provide farm profitability and social programs.

Federal subsidy programs help to preserve natural resources and create a lower-cost food and fiber economy.

The Food and Drug Administration, a governmental agency, determines how quickly new technologies can be implemented and verifies that new technologies are properly being used.

Agriculture and its related industries will need grass roots support, the United States government, and the world to feeding an ever expanding population.

Government involvement in agriculture is often misunderstood and seldom warranted.

Implementing environmental policies is essential to ensure a quality life for future generations.

The use of agricultural land for industrial and commercial development has created a need for controlled land use planning.

Agriculture largely determines state or national policies.

The government must recognize that the public values a viable food fiber chain for choice, quality, and value.

This nation needs a basic agricultural policy which concentrates on its owner-operated food production industry.

Government policy represents a contradiction in that farmers, who view themselves as independent and self-sufficient, are also heavily dependent upon governmental programs.

Our cheap food policies and subsidies seem necessary to ensure farm level profitability in view of severe foreign competition.

One of the criteria for agricultural policies is to ensure a constant supply of food and fiber at reasonable prices to an expanding population.

Publics around the world have chosen inexpensive food policies for consumers and have been willing to tax themselves to support farm incomes.
Table 9. (Continued)

Public agricultural policies must be drafted to strengthen the earning power of production agriculture without undermining public confidence in the industry.
Table 10. Agriculture's important relationship with natural resources

Conservation of natural resources

Agricultural methods exhibit mutual benefit for agriculture and natural resources; i.e., field borders for wildlife.

Our needs for agricultural production must be balanced against the depletion of our natural resources (soil, water, natural areas, and forest).

Soil is the basic ingredient for all life. Conservation of this resource is essential for the continuation of food production.

Animals are inefficient in the ratio of nutrients used to nutrients produced, but 85% of the world's population desires food of animal origin.

Land and water are two of the country's most important natural resources. As a primary user of these resources, agriculturalists must play the role of conservationists for the future survival of society.

As natural resources are consumed, especially without consideration for renewal, agriculture will be pressured to find alternatives.

Soil and water management/conservation protect other resources as well.

Agriculture directly and immediately affects underground water quality and soil erosion/productivity.

Soil erosion is a major agricultural problem.

The abundance and well-being of any animal and plant population may be used as an indication of the productivity of the land, its misuse or both.

The real wealth of a nation lies in its soil. The United States claims 60% of the Class I land in the world.

Sustainable agriculture

Agriculture is a form of managing natural resources for human use.

Crops can be produced while conserving our soil and water resources.
The basic starting materials for crop production (soil and water) must be managed and conserved in order to assure a strong economic future.

Crop rotation restores valuable soil nutrients.

The U.S. agricultural system currently is not operating on a long-term sustainable basis and is dangerously exploiting the land and water resources on which agriculture depends.

Sustainable agriculture is economically viable, environmentally sensitive and conserves the natural resource base.

Stewardship of agriculture

Natural resources must be used in balance with the world's need for food and with concern for the future.

Because agriculture is stewardship of natural and renewable resources, the interaction between agricultural industry and regeneration of our natural and renewable resources should be understood.

Careful use and storage of farm chemicals including herbicides, pesticides, fertilizers, and manure will ensure safe water supplies.

Farmers own and control a large part of the environment.

A successful and sustainable agriculture depends on stewardship of nature—soil, air, water—and public policies which reward wise use of resources.

Identification of agricultural conservation practices, old and new, which help farmers to be good stewards of the land.

Pollution and depletion of our natural resources

The impact of non-point source pollution of our water supplies.

Groundwater quality, pesticide residues, food safety, and other environmental concerns are becoming driving forces in agricultural decision making.
Co-dependent relationship between agriculture and natural resources

Agriculture interrelates closely with our natural resource base. Agriculture depends upon and affects that base through time.

Proper management of livestock and wildlife allows each to occupy forest and rangelands concurrently.

Importance of human beings' role (technology) in managing our natural resources to provide food, fiber and shelter needs as well as recreation, wildlife habitat, etc.

The production of food and fiber without destruction of the environment, while conserving renewable natural resources, is a co-dependent function and is integral to agriculture in the United States.

Importance for agriculture

Natural resources are required to maintain a productive, competitive agriculture.

Grazing land can often produce large quantities of domestic meat while maintaining wildlife populations such as elk, deer, and wild horses.

Agriculture represents one of our vital natural resources and must be given much greater priority as people proceed to build highways, parking lots, industrial parks, and housing developments.

New technologies make pesticide application and use safer and more rapidly biodegradable.

The production of plant products is a renewable resource capable of providing a continuing source of fuel.
Table 11. Production of animal products

Consumer concerns

Consumer concern over health issues is increasing and dictates that livestock producers strive to provide a healthy product.

Agricultural animals raised for food and fiber should be cared for in a humane, healthy environment.

The use of quality and yield grades in beef and swine have greatly increased the percentage of meat produced as well as the quality of the meat produced.

The domestication and management of animals/poultry for the private, and/or commercial production of food and by-products is basic to agriculture.

Animal products provide some of the greatest household conveniences and lifestyle conveniences we have today.

Animal production not only requires the four factors of production (land, labor, capital and management), but also requires freedom, opportunity, and incentives to create and produce.

Animal products, in addition to plant products are a significant source of human food and are the best source of protein.

Animal product production is alarmingly concentrated in the hands of fewer and fewer corporate producers which presents an even greater problem for our nation.

Revenue from animal agriculture accounts for a high percentage of farmers' income and also contributes significantly to the country's GNP.

Almost all animal products must be processed in order to sell them.

Factors influencing animal production must be based upon sound scientific and business principles.

The uses and roles of various animal species

The role of animal products in farming systems.

Animals are raised for food and fiber consumption and for their by-products.
Ruminants such as cattle and sheep convert low quality forages and plants grown on lands not suited for cultivation into high quality food for humans.

Animals raised for food are also invaluable for human medical treatments and provide us with materials that make our daily lives easier and safer.

Similarities and differences exist between various livestock operations because of species, environment, and management.

Production of animal products is an example of the second level of the energy transfer in the food chain (plant consuming or herbivorous).

Biotechnology and genetics

Breeding programs can improve production by using the same available feed and management resources.

The development of animal protein without the use of chemical hormones.

New and less costly embryo transfer processes improve cattle genetics.

Raising young bulls for beef, because of naturally occurring hormones, provides low fat beef.

Genetic and breeding technologies, through research, are expanding job opportunities and greatly improving food quality and quantity, and will continue to do so in the future.

Embryo manipulation technology provides a new level of technology that increases the economic importance of animals.

Concerns about chemicals used in animal production need to be acknowledged and addressed.

Biotechnology offers tremendous possibilities for greater efficiencies and improved economics in the production of animal units.
Table 11. (Continued)

Animal husbandry

Animal production facilities can cause stress. The physical environment in which animals are kept determines the amount of stress to which animals are subjected.

Confinement feeding affects the requirements for raising livestock increasing the need for proper ventilation and waste control.

Efficient animal production depends upon proper management practices relating to health, nutrition, reproduction, and the environment.

When considering livestock/animal production, each type of animal needs certain nutritional requirements. Ruminants have different requirements from poultry or swine and each fits into a different management scheme.
Table 12. Societal significance of agriculture

Society's lack of awareness

Increased societal understanding of scientific agricultural advancements by society.

A truly sustainable food system is achieved by treating agriculture as an essential industry.

The relationship between American values and prosperity and the continuing physical and social interdependency of producers and consumers in our rapidly changing society.

People must possess a better understanding of agriculture's role in society.

Identify the path of food and fiber products from the point of origin to the consumer.

Agriculture's effect on society

The effect of the "agrarian society" on our own current national attitudes; i.e., "belief" in individual land ownership.

Social programs involve agriculture and have an impact on consumers, producers, and tax payers.

An awareness of how agriculture has shaped the behavior, norms, and values of society and vice versa.

The availability and cost of agricultural products are a major determining factor in a society's health and stability.

Food and fiber not only sustain society and provide major economic activity, but also impact international issues such as defense, trade and monetary policy.

Animals raised for food are also an invaluable resource in the production and availability of human medical products. Some of these animal-produced medical products include: insulin, cortisone, estrogen, epinephrine, and replacement heart valves.

Food surpluses and shortages have dramatically changed human society in the past and continue to have major impacts on migration, political structure and stability, the beginnings and endings of wars, and the global economy.
Table 12. (Continued)

Rural life

Agriculture today provides a substandard level of living for people in the production phase compared to other jobs and industries where labor earns much higher wages.

The American farmer is the person most responsible for the quality of life enjoyed by almost all.

Farm youth, because of their socioeconomic environment, possess unique attitudes toward family structure, religion, and careers.

Agriculture provides a "way of life" that fulfills thousands of peoples' needs such as caring for animals, growing plants, and protecting the environment.

Rural economies have been affected by the 30-year decline in the number of people involved in farming.

Rural America and agriculture have influenced American values and philosophies.

Work ethics and morals of people raised in rural areas are highly valued.

Today, the farmer feeds 110 people and provides employment opportunities for another 50.

The change of rural social structure is due in part to changes in agriculture.

Although similarities exist, interests and activities of people living in farm communities differ from those people who live in cities.

Rural America provides green space and open areas for urban America and a renewable resource that benefits all society.

Farming has changed from a way of life for farm families, to a more purely business enterprise.

Farmers have and continue to participate in unique social and work functions with fellow farmers; i.e., field work, butchering, and mechanical repair.
American agriculture has undergone a revolution in farm numbers, resource substitution, and productive capacity.

**Societal benefits**

Stable societies are built after a reliable, diverse, and available food and fiber supply are ensured.

The small amount of dollars spent by the American consumer for food allows consumers to spend additional income to enhance other economic sectors of American commerce.

Society must recognize that agriculture is the only essential industry and care must be taken to ensure its future.

Regardless of the nation or period of history, agriculture serves as the economic backbone for countries of the world.

Technological advances in agriculture have allowed workers to work in other industries.

Without adequate quantities and quality of food, people revolt.

Agriculture is the base of economic, political, and social power in the world arena.

**Food efficiency**

The efficiency of United States agriculture is reflected by relatively low food prices.

Cultural aspects of given populations influence meat consumption. Animal products supply 25% of dietary energy in developed countries, but only 7% in developing countries.
Table 13. Production of plant products

Greenhouse/gardens

The production of greenhouse, nursery, and landscape plants is becoming increasingly important because urban areas contain high concentrations of consumers.

Raising a garden can be educational, fun and healthy.

Horticultural crops have great growth potential in furnishing food for consumers of the future.

Use and care of plants

Identification of the top ten agriculture plants/crops (by gross sales) and their uses in society.

Plants are grown for human and livestock consumption and for use in industrial applications.

Whatever is removed from the soil must be recycled, not mined. Otherwise, the waste left becomes a pollutant.

By-products of crop production can be used for food items such as vegetable oil as well as textile uses.

The planting, culture and management of plants (crops) for private and/or commercial production of food and fiber is basic to agriculture.

Plants are energy transducers; they take solar radiation and convert it to usable chemical energy in the form of carbohydrates such as starch and cellulose.

Plant production provides the initial source of all food and fiber and serves as the basis for the animal industry.

Plant products are the principal source of human food and fiber needs.

Citizens should be aware of the basic components of crop farms; learn the wide variety of crops, their uses for food, feed, fiber, and building; will see that different products come from different types of farms.
Biotechnology, biology, and genetics

Improvement of the biological potential of plants will be a focus of agronomic research in the future.

The macro and micro nutrients available in the soil medium must match the plants' needs for maximum economical needs.

Crops can be produced profitably by reduced use of pesticides.

Care must be taken in pesticide application to protect all segments of the population.

Improved varieties and drip irrigation account for increased and better quality yields of fruits and vegetables.

Genetics and increased knowledge of basic production practices have increased yields of most domestic crops.

Biotechnology has allowed scientists to use tissue culturing as a means of developing resistant varieties of crops to insects, diseases and chemicals.

Biotechnology's effect on plant yield and resistance could reduce input costs and increase profitability of crops.

Selective breeding of plants produces cultivars which can grow in a number of less favorable environmental conditions.

Biotechnology and the development of new plant varieties will increase food production in the world. Development of plants which can survive with much less water than normal could have a profound effect on stretching water resources.

Use of insecticides is essential to quantity and quality of food for both human and animal consumption.

Proper planting, irrigation, fertilization, and pest control are practices that the producer can control.

Vegetative propagation is the only way to maintain clones. Clones are a group of genetically similar plants which arise from a single parent plant.

Photosynthesis uses solar energy to provide the only source of food for animals, including humans.
The plant production system is a physically efficient producer of food, fiber, and industrial resources but must become more environmentally and economically efficient.

New biodegradable products for industrial use will become the most important new area of plant production and development.

Genetic engineering will invoke the greatest change in the production of plant products since humans began the cultivation of plants.

Increasing reliability and performance of cultivars under a range of environments often less than ideal, is vital in meeting consumer food, feed, and fiber needs in both developed, and especially developing nations.

Agronomic practices

Plant growth requires the primary nutrients found in soil: nitrogen, phosphorous, and potassium.

Basic agronomic/biological processes associated with plant growth are applied to produce all domestically grown food.

Careful agronomic management of the plant environment and variety selection results in optimum crop production.

Plant production techniques will continue to change to meet world demand.

While crops may not need soil to grow, there is a need for media to provide a stable source of nutrient uptake by the roots.

Crops can be produced with or without agricultural pesticides.

Quality, efficiency, and environmental concerns/risk must be managed and balanced.

Profit

Optimum production at a profit: more bushels do not always provide the economic return to cover the costs of production.

Plant production requires large investments of capital.
Table 13. (Continued)

Society

Because plants (due to photosynthesis) are the base of the food chain, the complexities and fragility in the production of plant crops must be understood. Also appreciated should be the dependence mankind has placed on a mere 29 species of the 3,000 edible food-type plants.

A balance of natural and man-influenced cultural practices is necessary in the production of plant products to ensure an adequate, healthy food supply.

Plant and animal production not only requires the four factors of production (land, labor, capital and management), it also requires freedom, opportunity, and incentives to create and produce.

Plant production in our nation is still largely in the hands of owner-operated farms—fortunately, for consumers as well as farmers.

Almost all plant products must be harvested, cleaned, graded, and packaged as a part of producing the product.

There will be an increased demand for plant production for human consumption in the future because of an increase in world population.

Most of the resources we use every day come from plants; i.e., fuel, furniture, food, clothing, shelter, clean air, and many healthy products.

One-third of the grain produced in our nation is exported.

Current regulatory pressures to reduce inputs place production at risk at a time when world population will increase by one billion people in the next ten years.
Table 14. Economic impact of agriculture

Macroeconomics/microeconomics

Besides production agriculture, support and service industries greatly add to agriculture's economic influence.

The current impact agriculture has on the U.S. balance of trade and gross national product.

The effect agriculture has on value added products (vice versa).

The economic impact (micro as well as macro) that the agriculture industry has on every individual as well as the community and nation as a whole.

National economic viability ultimately depends on investments in human resources, science, technology, and wise use of soil, water, and other natural agricultural endowments.

Supplies, materials, and labor that are used for food and fiber production in addition to processing, marketing, and the consumption of agricultural products contribute to the global economy.

Interest rates, land values, foreign exchange, and other economic factors have a considerable impact on agriculture.

Soybean exports account for about half the United States crop. These exports help the U.S. balance of trade and are essential to farm profit.

The agriculture industry is the largest industry in the United States involving production, distribution, processing, and input manufacturing of agricultural products.

Advancements based on biotechnology and genetic engineering will help stabilize food prices and help our economy.

Agriculture has assets of $1 trillion.

The United States agriculture impact on world markets will diminish as other countries become dominant in foreign markets.

Production agriculture, as well as agricultural sales, services, and processing have a significant effect on the local, state, and national economy through employment, cash exchange, a strong economic tax base, and nonrelated sales and services.
Tourism, hunting, fishing, hiking, and other industries rely on the open spaces agriculture provides.

For every dollar of farm product value, more than $7 of economic activity is generated off the farm.

The economic impact of agriculture can best be emphasized through a case study of a rural agricultural community which has been the economic victim of farm foreclosures, droughts, and/or other natural disasters and the effect of agriculture on the average citizen.

Agriculture's impact is seriously underestimated by American citizens and our national leadership.

Four out of ten acres under cultivation in the United States are grown for export, therefore reducing our Trade Deficit.

Intensification of agriculture in urbanized areas and economy of scale in rural areas are fundamentally important to the profitability of a farm enterprise.

Farm exports generate considerable employment, income, and purchasing power in the farm and nonfarm sectors. In 1987, $28.6 billion of exported agricultural goods and supporting services generated a total of $75.8 billion in economic activity.

Farm management

Profit is more important than gross revenue of total production. A producer must balance inputs with outputs in order to be profitable.

Hedging to control risk involved in marketing or purchasing agricultural commodities.

Farm programs dictate profitable production systems.

Approximately 50% of the individuals who live on farms or ranches earn the majority of their income from sources other than agriculture.

Although integrated pest management is generally thought of as an environmentally based approach, it has been adopted by the agriculture industry because of its economic benefit.

Many factors beyond the producer's control affect the production of food.
Table 14. (Continued)

<table>
<thead>
<tr>
<th>Economic benefits and food costs</th>
</tr>
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<tbody>
<tr>
<td>Agriculture, in its broadest sense, is the single largest industry in the United States and affects the lives and well-being of every citizen.</td>
</tr>
<tr>
<td>Efficient agricultural production minimizes the expenditure of disposable income for food by U.S. citizens compared to other nations.</td>
</tr>
<tr>
<td>The quality of daily life is dependent on the quality and quantity of agricultural food and fiber products.</td>
</tr>
<tr>
<td>Percentage of all employees involved in some aspect of the agriculture industry.</td>
</tr>
<tr>
<td>No human society can survive if it forgets its basic needs; fails to foster its food, fiber, and mineral supply lines; or fails to allow producers to produce.</td>
</tr>
<tr>
<td>Agriculture is the largest single employer in the United States.</td>
</tr>
<tr>
<td>Agricultural economic health is important to all consumers.</td>
</tr>
<tr>
<td>Efficient production of agricultural products to meet essential human needs releases human capital for the production of nonagricultural commodities and in turn increases the standard of living and quality of life while providing the raw material for industrial development.</td>
</tr>
</tbody>
</table>
Table 15. The marketing of agricultural products

Marketing plan and strategy

The marketing process for agricultural products.

Surplus production increases the need for creative agricultural marketing.

Product development.

Agricultural marketing must become more comprehensive, including a long-range plan for every step of the process.

The producer must have control of marketing his/her products to make a consistent profit.

Farm profits depend on the use of a marketing plan and modern marketing methods.

Modern American lifestyles demand alternative market niches.

Profitable agricultural marketing relies on accurate production cost figures.

Agricultural success largely depends on effective marketing strategies and techniques.

To profit, farmers must sell their products for a price higher than production costs.

Producers must become more proficient in agricultural marketing.

A marketing strategy helps a producer obtain a given product price.

Global marketing

The continued development of proven and new agricultural products relies on worldwide market strategies.

The marketing strategies and technologies used in agriculture are the same used by other industries.

Agricultural products make up the major share of United States exports.

Agricultural product marketing is basically supply and demand economics on a global scale.
Table 15. (Continued)

Globalization has created a rethinking of the marketplace and the role of agriculture in the international arena.

Exports are a key to a healthy agricultural economy. We must lower trade barriers for the good of all economies.

Major concerns of worldwide agriculture include agricultural products, transformation, and transportation.

Agriculture's function in a market-oriented economy

The variables and their constraints that affect the agricultural marketing should be identified.

Market-oriented agriculture must be more sensitive to foreign and domestic consumers' preferences.

The producer cannot control all the factors that affect the agricultural pricing system.

Trace agricultural products to the point of sale for further processing and/or consumption (the concept of basis).

Adding value to products produced by agriculture can make an economic difference to all segments of the food chain.

Consumers enjoy fresh fruits, vegetables, and staple goods in this country because of a marketing system that includes producers, brokers and transporters.

The price received for a given product is influenced by supply and demand (basic economic forces) for that product.

Processing and distribution are part of the flow of raw inputs that provide our essential supplies.

The marketing of agricultural products must be based upon an open market system. To assure market openness, trade and cultural restrictions must be reduced.

Computers can provide sophisticated agricultural market analysis.

Marketing principles influence who stays in the agricultural production, processing, shipping, and retaining business.

Agricultural products represent a large part of a nation's economy.
Table 15. (Continued)

Consumers often buy agricultural products without a thorough knowledge of the different grades of products available (i.e., meat and eggs).

An economically viable agriculture provides a reasonable return for a producer's time, energy, and talent.

Futures trading is a procedure used in the agricultural commodity markets to protect profits, stabilize prices, and reduce fluctuations of product flow.

Marketing is the process of satisfying human needs and wants by bringing products to people in the proper form, at the proper time and in the proper place.

The marketing system enables producers and consumers to communicate needs and limitations to one another through a freely moving price mechanism.

Major issues in marketing agricultural products revolve around product acceptability, availability and costs.

Public perception

Agriculture must be seen as a component of the food system which includes consumers. Since every component of a system affects the whole, it's important that consumers recognize that what they eat impacts agriculture.

The livestock industry is taking a big step in promoting its product through the national "Checkoffs."

A high proportion of the retail costs results from marketing costs (cost of transportation, advertising, processing, and packaging) which occur after the products leave the farm.

Handlers, processors, and speculators dominate agricultural marketing more than the product producers.

Seventy-five cents of every dollar spent by consumers on food goes to marketing firms.

Two-thirds of agricultural commodities are marketed by farmers in the lower one-third of the annual price range for that particular commodity.
Table 16. The distribution of agricultural products

The distribution system and its importance

The distribution of agricultural products involves all other sectors of the economy.

The agricultural distribution process ranks in importance with agricultural production, marketing, and processing.

Movement of agricultural products from the farm to processing and ultimately to the consumer is a critical step in the flow of raw materials that provides our essential supplies.

The distribution and marketing of most agricultural products have changed so they are available throughout the year.

Distribution of agricultural products is easily equated with the profitability of production.

The United States distribution has worked well and will become more efficient, but will be conducted mainly by truck.

The worldwide system for agricultural product distribution is the key to United States agriculture's ability to compete on an equivalent basis with all producing countries.

The distribution of agricultural products involves many skills and trades.

The interrelation of variables (including infrastructure) affecting the timely distribution of desirable and usable agricultural products should be known.

The American consumer has access to a larger variety and quantity of fresh and processed domestic and imported foods.

Improved distribution techniques allow regional specialties to gain acceptance in other areas of the country.

The food distribution system includes excellent communications systems, transportation systems, elevators, and point facilities.

The timely, safe, and economic transportation of food and fiber to the consumer challenges our food and fiber system.
Table 16. (Continued)

Efficient transportation of food and fiber in our country greatly enhances the quality of the products and decreases perishability.

Distribution of agricultural products is second only to production in importance to a stable farm economy and to an individual standard of living.

Transportation, wholesaling, and retailing account for a large portion of every dollar spent by consumers on food eaten at home.

The food chain phenomenon: make the connection between skilled labor, quality transportation, marketing outlets, warehousing, processing, packaging, retailing (both direct and with a myriad of middlemen) for a balanced and complete food/feed/fiber/flora array of products for the end consumer here and abroad.

Global distribution and hunger

International markets must be efficiently managed to provide the highest quality product at the lowest possible price.

Much of the world's hunger arises not from a failure to produce food, but a failure in getting food from where it is produced to where people need it.

Compare and evaluate the United States system of agricultural product distribution with foreign systems.

A country's ability to distribute an agricultural product within the country, limits export sales to that country.

Worldwide distribution of agricultural products largely depends on the cost of energy.

Sixty-seven percent of the world's meat and 80% of the world's milk is produced by people residing in developed countries.

United States agriculture functions within a global market. The product of one out of every three acres is shipped abroad.

Agricultural products compete on a world market; yet the United States imports more agricultural products than it exports.

The distribution phase of agricultural marketing includes vertical and horizontal integration.
Efficient systems for the distribution of agricultural products exist in developed countries but remain inefficient or nonexistent in developing countries.

Cost of distribution

Surplus garden produce is tracked at produce markets to meet demand at other locations.

When agricultural products, especially perishable items, can be produced near the consumer, transportation costs decrease and the product quality increases (basis).

Transportation and logistics affect the distribution of food from production areas to consumption areas.

Transporting processed products to areas of greatest consumption is more economical than transporting raw products.

Transportation costs can account for a large percentage of the retail price of many agricultural products.

Efficiency of distribution

Distributing agricultural products to their needed location in a timely and cost efficient manner is one of the most critical issues of the 1990s.

Each commodity has its own specific transportation requirements, whether it be cheap bulk transport or rapid refrigerated transport.

Distribution sector employment

A large number of distribution jobs depend on agriculture.

As society evolves, fewer producers in fewer locations can produce the agricultural needs of the whole society partially because of a more effective transportation system.
Table 17. The global significance of agriculture

Global food economics

The global food providers and users are dependent on each other.

A certain commodity's price determines its worldwide availability.

Foreign and domestic government's agricultural policy affect trade, world tension, conflicts, and human suffering.

All citizens should be aware of the co-dependency of individuals, communities, and nations for both agricultural inputs and products.

Sound trade policies contribute to the long-term economic vitality of American agriculture.

Our production practices are greatly affected by world markets and exchange.

Agriculture has become a worldwide business that can create worldwide competition.

Improvements in communications and transportation have resulted in more world markets.

The "shrinkage" of the globe has provided important new opportunities for marketing agricultural products as well as new sources of competition.

Agricultural goods are consumable products and a contributor to the gross national product, thereby laying a critical role in the global economy.

Our competitiveness is no longer assured in a global market.

Exports are the key to success for United States agriculture.

Agriculture is capable of feeding the world if products could be economically distributed to shortage areas.

Weather, trade barriers, exchange rates, trade balances, value of agricultural production, consumption, and distribution impact production and distribution.

The international marketing of animal and plant genetics contributes to global agricultural trade.
Table 17. (Continued)

The United States has its agricultural exports because it has taught third world countries how to farm.

Agriculture, the most basic industry in every nation in the world, does indeed make the difference between development or starvation.

Demand for agricultural exports depends on global production, capital, markets, world climate, and international economies, and policies of other countries.

Food, fiber, and other agriculturally derived products constitute a major share of domestic and international trade in almost every world nation.

Global politics/sociology

Agriculture plays an important role in determining policies for working with all nations of the world.

No human society can survive if it forgets its basic needs, fails to foster its food, fiber, and mineral supply lines or fails to allow producers to produce.

Agriculture is too domestically important to become the foreign policy tool of any nation.

Agricultural products and policies have a major impact on international trade relations.

Agriculture greatly influences state and national policies.

There is no substitute for a rational educated approach to maintaining an adequate global food supply.

Since agriculture is one of the most basic requirements for continued life on earth, it provides an opportunity for forming a global community.

Technology and university research

Technological advances have increased world food supplies.

A large number of foreign students study agriculture in the United States because of its world-renowned land grant universities.
Some countries compete with the United States in foreign agricultural markets because they have adopted advanced technologies developed in the United States, such as genetics and chemicals.

Global hunger and food distribution

Agriculture greatly affects the worldwide standard of living and lifestyle.

Because of the unbalanced distribution of natural resources, food is not available equally, causing food distribution to become a critical economic and social issue.

The world hunger problem can be attributed to many factors that influence food production and distribution in the developing world.

Malnutrition, infection, and the lack of clean water supplies are serious problems affecting the world's inhabitants. Improved food distribution and production can decrease malnutrition.

Adjusting the global supply and demand of food would alleviate fears of a world food shortage.

World population tends to increase geometrically, while food production increases arithmetically.

Agricultural policies influence and are influenced by global factors.
Comparison of Panelists' Rankings

In addition to obtaining information about the panelists' background, the demographic questionnaire asked panelists to rank the concept areas in terms of importance and by panelists' knowledge about the concept area. Concept areas were ranked from 1 through 11 (1 = most important, 11 = least important) in terms of their importance to agricultural literacy. Panelists were asked to list the concept areas they felt they possessed the most knowledge from most to least knowledge possessed. Regarding the ranking of concept knowledge possessed, panelists were told they could rank as few or as many concept areas in which they felt knowledgeable. The ranking scale was inverted for testing and graphic presentation purposes (11 = most important, 1 = least important). The average ranks are graphically displayed in Figure 14.

![Figure 14. Panelists' average ranks of concept area importance and concept area knowledge](image-url)
A number of statistical tests were performed to analyze panelists' rankings. The panel's mean rankings of the 11 concept areas were compared to the ranking of the concept knowledge possessed using the Wilcoxon Rank Sum test and correlated using the Spearman-Rank correlation. Expert and nonexpert panelists' mean rankings were compared by using the Mann-Whitney U-test. The Mann-Whitney U-test was also used to compare mean rankings of the panelists who read the NAS study with the mean rankings of the panelists who did not read the NAS study. A Kruskal-Wallis test was conducted to determine if any of the three panelists' occupational areas mean rankings were significantly different. Finally, a Dunn's Multicomparison procedure was performed to determine where differences in mean rankings of the three panelists' occupational areas were located.

A Spearman-Rank correlation procedure was conducted to determine if any significant relationship existed between the ranking of panelists' concept area importance and concept area knowledge. Five concept area importance rankings were significantly correlated with the concept area knowledge rankings. They included: (1) agriculture's important relationship with the environment; (2) the processing of agricultural products; (3) the economic impact of agriculture; (4) agriculture's important relationship with natural resources; and (5) the production of animal products. Table 18 presents the Spearman-Rank correlation values between concept area importance and concept area knowledge.

A Wilcoxon Rank Sum test was performed to determine if the mean rank of a certain concept area importance was significantly different from the
Table 18. Spearman-Rank correlations between the concept area importance rank and concept area knowledge rank by panelists

<table>
<thead>
<tr>
<th>Concept area</th>
<th>R-value</th>
<th>R-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture's important relationship with the environment</td>
<td>.354</td>
<td>.013*</td>
</tr>
<tr>
<td>The processing of agricultural products</td>
<td>.444</td>
<td>.009**</td>
</tr>
<tr>
<td>Public agricultural policies</td>
<td>.240</td>
<td>.114</td>
</tr>
<tr>
<td>Agriculture's important relationship with natural resources</td>
<td>.357</td>
<td>.014*</td>
</tr>
<tr>
<td>Production of animal products</td>
<td>.271</td>
<td>.036*</td>
</tr>
<tr>
<td>Societal significance of agriculture</td>
<td>.256</td>
<td>.066</td>
</tr>
<tr>
<td>Production of plant products</td>
<td>.248</td>
<td>.052</td>
</tr>
<tr>
<td>Economic impact of agriculture</td>
<td>.417</td>
<td>.004**</td>
</tr>
<tr>
<td>The marketing of agricultural products</td>
<td>.168</td>
<td>.167</td>
</tr>
<tr>
<td>The distribution of agricultural products</td>
<td>.097</td>
<td>.325</td>
</tr>
<tr>
<td>The global significance of agriculture</td>
<td>.145</td>
<td>.214</td>
</tr>
</tbody>
</table>

*Significant at the .05 level.  
**Significant at the .01 level.
mean rank of the corresponding concept area knowledge ranking. Four pairs of mean ranks were found to be significantly different. The pairs of ranks included: (1) the production of animal products; (2) the production of plant products; (3) the marketing of agricultural products; and (4) the global significance of agriculture. Table 19 depicts the Wilcoxon Rank Sum test values for the 11 concept areas.

Expert and nonexpert panelists' rankings were compared using the Mann-Whitney U-test to determine if any of the mean rankings of the two groups were significantly different. The mean rankings of the two groups differed significantly between the following concept areas: (1) the social significance of agriculture concept area importance; (2) the processing of agricultural products concept area knowledge; (3) the production of animal products concept area knowledge; (4) the marketing of agricultural products concept area knowledge; and (5) the distribution of agricultural products concept area knowledge. Table 20 delineates the Mann-Whitney U-test values for the comparison of the expert and nonexpert panelists' ranks regarding concept area importance. Table 21 presents the Mann-Whitney U-test values for the comparison of the expert and nonexpert panelists' ranks regarding concept area knowledge.

A Mann-Whitney U-test was also conducted to determine if any differences existed between the mean ranks of panelists who read the NAS study and the panelists who did not read the NAS study. No significant differences existed between the two groups based on the results from the Mann-Whitney U-test. Tables 22 and 23 present the values of this test.

The three panelists' occupational areas allowed conduct of the
Table 19. Results of the Wilcoxon Rank Sum test to determine significant differences between the corresponding pair of the panelists' concept area importance and concept area knowledge mean ranks

<table>
<thead>
<tr>
<th>Concept area importance</th>
<th>Concept area knowledge</th>
<th>Z-value</th>
<th>Z-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Environment</td>
<td>-0.094</td>
<td>0.926</td>
</tr>
<tr>
<td>Processing</td>
<td>Processing</td>
<td>-1.607</td>
<td>0.108</td>
</tr>
<tr>
<td>Public policies</td>
<td>Public policies</td>
<td>-1.088</td>
<td>0.277</td>
</tr>
<tr>
<td>Natural resources</td>
<td>Natural resources</td>
<td>-0.285</td>
<td>0.776</td>
</tr>
<tr>
<td>Animal production</td>
<td>Animal production</td>
<td>-5.930</td>
<td>0.000**</td>
</tr>
<tr>
<td>Social significance</td>
<td>Social significance</td>
<td>-1.657</td>
<td>0.975</td>
</tr>
<tr>
<td>Plant production</td>
<td>Plant production</td>
<td>-5.175</td>
<td>0.000**</td>
</tr>
<tr>
<td>Economic impact</td>
<td>Economic impact</td>
<td>-1.111</td>
<td>0.267</td>
</tr>
<tr>
<td>Marketing</td>
<td>Marketing</td>
<td>-4.413</td>
<td>0.000**</td>
</tr>
<tr>
<td>Distribution</td>
<td>Distribution</td>
<td>-1.008</td>
<td>0.314</td>
</tr>
<tr>
<td>Global significance</td>
<td>Global significance</td>
<td>-2.630</td>
<td>0.0085**</td>
</tr>
</tbody>
</table>

**Significant at the .01 level.
Table 20. Comparison of concept area importance mean rankings by expert and nonexpert panelists using results from the Mann-Whitney U-test

<table>
<thead>
<tr>
<th>Concept area importance</th>
<th>Expert panelists' mean rank</th>
<th>Nonexpert panelists' mean rank</th>
<th>U-value</th>
<th>U-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>32.99</td>
<td>35.81</td>
<td>472.5</td>
<td>0.056</td>
</tr>
<tr>
<td>Processing</td>
<td>35.57</td>
<td>31.19</td>
<td>448.5</td>
<td>0.369</td>
</tr>
<tr>
<td>Public policies</td>
<td>30.94</td>
<td>39.48</td>
<td>384.5</td>
<td>0.082</td>
</tr>
<tr>
<td>Natural resources</td>
<td>34.99</td>
<td>32.23</td>
<td>473.5</td>
<td>0.573</td>
</tr>
<tr>
<td>Animal production</td>
<td>34.72</td>
<td>32.71</td>
<td>485.0</td>
<td>0.679</td>
</tr>
<tr>
<td>Social significance</td>
<td>29.94</td>
<td>41.27</td>
<td>341.5</td>
<td>0.018*</td>
</tr>
<tr>
<td>Plant production</td>
<td>35.21</td>
<td>31.83</td>
<td>464.0</td>
<td>0.492</td>
</tr>
<tr>
<td>Economic impact</td>
<td>31.13</td>
<td>39.15</td>
<td>392.5</td>
<td>0.101</td>
</tr>
<tr>
<td>Marketing</td>
<td>33.95</td>
<td>34.08</td>
<td>514.0</td>
<td>0.978</td>
</tr>
<tr>
<td>Distribution</td>
<td>34.59</td>
<td>32.94</td>
<td>490.5</td>
<td>0.735</td>
</tr>
<tr>
<td>Global significance</td>
<td>35.38</td>
<td>31.52</td>
<td>456.5</td>
<td>0.423</td>
</tr>
</tbody>
</table>

*Significant at the .05 level.
Table 21. Comparison of concept area knowledge mean rankings by expert and nonexpert panelists using results from the Mann-Whitney U-test

<table>
<thead>
<tr>
<th>Concept area knowledge</th>
<th>Expert panelists' mean rank</th>
<th>Nonexpert panelists' mean rank</th>
<th>U-value</th>
<th>U-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>22.12</td>
<td>15.65</td>
<td>101.5</td>
<td>0.131</td>
</tr>
<tr>
<td>Processing</td>
<td>16.33</td>
<td>9.00</td>
<td>35.0</td>
<td>0.037*</td>
</tr>
<tr>
<td>Public policies</td>
<td>14.14</td>
<td>13.40</td>
<td>52.0</td>
<td>0.850</td>
</tr>
<tr>
<td>Natural resources</td>
<td>21.93</td>
<td>15.67</td>
<td>110.0</td>
<td>0.109</td>
</tr>
<tr>
<td>Animal production</td>
<td>25.60</td>
<td>17.80</td>
<td>147.0</td>
<td>0.049*</td>
</tr>
<tr>
<td>Social significance</td>
<td>17.78</td>
<td>21.50</td>
<td>80.5</td>
<td>0.391</td>
</tr>
<tr>
<td>Plant production</td>
<td>25.14</td>
<td>17.13</td>
<td>127.5</td>
<td>0.063</td>
</tr>
<tr>
<td>Economic impact</td>
<td>20.13</td>
<td>19.71</td>
<td>158.5</td>
<td>0.914</td>
</tr>
<tr>
<td>Marketing</td>
<td>21.07</td>
<td>12.13</td>
<td>67.5</td>
<td>0.013*</td>
</tr>
<tr>
<td>Distribution</td>
<td>15.35</td>
<td>5.57</td>
<td>11.0</td>
<td>0.002**</td>
</tr>
<tr>
<td>Global significance</td>
<td>17.73</td>
<td>15.55</td>
<td>105.0</td>
<td>0.538</td>
</tr>
</tbody>
</table>

*Significant at the .05 level.
**Significant at the .01 level.
Table 22. Comparison of concept area importance mean rankings by panelists who read the NAS study and panelists who did not read the NAS study using results from the Mann-Whitney U-test

<table>
<thead>
<tr>
<th>Concept area importance</th>
<th>Panelists who read the NAS study mean rank</th>
<th>Panelists who did not read the NAS study mean rank</th>
<th>U-value</th>
<th>U-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>31.57</td>
<td>38.98</td>
<td>385.5</td>
<td>0.140</td>
</tr>
<tr>
<td>Processing</td>
<td>31.59</td>
<td>38.93</td>
<td>386.5</td>
<td>0.141</td>
</tr>
<tr>
<td>Public policies</td>
<td>34.30</td>
<td>33.39</td>
<td>481.5</td>
<td>0.855</td>
</tr>
<tr>
<td>Natural resources</td>
<td>33.38</td>
<td>35.27</td>
<td>467.0</td>
<td>0.705</td>
</tr>
<tr>
<td>Animal production</td>
<td>32.07</td>
<td>37.95</td>
<td>408.0</td>
<td>0.236</td>
</tr>
<tr>
<td>Social significance</td>
<td>33.58</td>
<td>34.86</td>
<td>476.0</td>
<td>0.794</td>
</tr>
<tr>
<td>Plant production</td>
<td>31.47</td>
<td>39.18</td>
<td>381.0</td>
<td>0.125</td>
</tr>
<tr>
<td>Economic impact</td>
<td>33.14</td>
<td>35.75</td>
<td>456.5</td>
<td>0.602</td>
</tr>
<tr>
<td>Marketing</td>
<td>34.36</td>
<td>33.27</td>
<td>479.0</td>
<td>0.829</td>
</tr>
<tr>
<td>Distribution</td>
<td>35.02</td>
<td>31.91</td>
<td>449.0</td>
<td>0.534</td>
</tr>
<tr>
<td>Global significance</td>
<td>34.16</td>
<td>33.68</td>
<td>488.0</td>
<td>0.923</td>
</tr>
</tbody>
</table>
Table 23. Comparison of concept area knowledge mean rankings by panelists who read the NAS study and panelists who did not read the NAS study using results from the Mann-Whitney U-test

<table>
<thead>
<tr>
<th>Concept area knowledge</th>
<th>Panelists who read the NAS study mean rank</th>
<th>Panelists who did not read the NAS study mean rank</th>
<th>U-value</th>
<th>U-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>20.20</td>
<td>21.40</td>
<td>141.0</td>
<td>0.776</td>
</tr>
<tr>
<td>Processing</td>
<td>14.07</td>
<td>15.79</td>
<td>64.5</td>
<td>0.626</td>
</tr>
<tr>
<td>Public policies</td>
<td>15.24</td>
<td>9.67</td>
<td>37.0</td>
<td>0.127</td>
</tr>
<tr>
<td>Natural resources</td>
<td>20.48</td>
<td>18.39</td>
<td>120.5</td>
<td>0.624</td>
</tr>
<tr>
<td>Animal production</td>
<td>23.03</td>
<td>22.93</td>
<td>224.0</td>
<td>0.980</td>
</tr>
<tr>
<td>Social significance</td>
<td>18.13</td>
<td>20.33</td>
<td>79.0</td>
<td>0.633</td>
</tr>
<tr>
<td>Plant production</td>
<td>23.74</td>
<td>20.73</td>
<td>162.0</td>
<td>0.497</td>
</tr>
<tr>
<td>Economic impact</td>
<td>21.89</td>
<td>15.18</td>
<td>101.0</td>
<td>0.094</td>
</tr>
<tr>
<td>Marketing</td>
<td>19.85</td>
<td>14.46</td>
<td>95.5</td>
<td>0.134</td>
</tr>
<tr>
<td>Distribution</td>
<td>13.80</td>
<td>10.33</td>
<td>48.0</td>
<td>0.242</td>
</tr>
<tr>
<td>Global significance</td>
<td>18.40</td>
<td>13.28</td>
<td>74.5</td>
<td>0.173</td>
</tr>
</tbody>
</table>
Kruskal-Wallis test to determine if any difference existed between the mean rankings of the groups. The mean rankings of the three groups differed significantly among the following concept areas: (1) the processing of agricultural products concept area importance; (2) the production of plant products concept area knowledge; (3) the marketing of agricultural products concept area knowledge; and (4) the global significance of agriculture concept area knowledge. Results of this test concerning concept area importance are presented in Table 24. Table 25 depicts the test results for concept area knowledge.

The Dunn's Multicomparison Procedure was conducted to determine where the differences in the mean rankings existed among the three panelists' occupational areas. The mean ranking of the elementary and secondary education panelists differed significantly from the agricultural industry panelists and the higher education panelists regarding concept area importance of the processing of agricultural products. The mean ranking of the agricultural industry panelists differed significantly from the higher education panelists concerning concept area knowledge about the marketing of agricultural products concept area. The procedure determined that a significant difference existed in the mean rankings between elementary and secondary education panelists and higher education panelists regarding concept area knowledge about the production of plant products. A significant difference was also found between the mean rankings of agricultural industry panelists and higher education panelists regarding concept area knowledge about the production of plant products. Although the Kruskal-Wallis test results
Table 24. Comparison of subject area importance mean rankings by the three panelists' occupational categories using results from the Kruskal-Wallis test

<table>
<thead>
<tr>
<th>Subject area importance</th>
<th>Occupational categories</th>
<th>1 Mean ranks</th>
<th>2 Mean ranks</th>
<th>3 Mean ranks</th>
<th>H-value</th>
<th>H-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture's important relationship with the environment</td>
<td>1 = Agricultural industry panelists; 2 = Elementary and secondary education panelists; 3 = Higher education panelists.</td>
<td>35.20</td>
<td>34.28</td>
<td>34.14</td>
<td>0.180</td>
<td>0.914</td>
</tr>
<tr>
<td>The processing of agricultural products</td>
<td></td>
<td>39.25</td>
<td>25.63</td>
<td>38.86</td>
<td>6.752</td>
<td>0.034*</td>
</tr>
<tr>
<td>Public agricultural policies</td>
<td></td>
<td>33.70</td>
<td>38.00</td>
<td>31.92</td>
<td>1.824</td>
<td>0.402</td>
</tr>
<tr>
<td>Agriculture's important relationship with natural resources</td>
<td></td>
<td>31.85</td>
<td>35.91</td>
<td>35.32</td>
<td>0.478</td>
<td>0.787</td>
</tr>
<tr>
<td>Production of animal products</td>
<td></td>
<td>35.40</td>
<td>28.91</td>
<td>38.92</td>
<td>3.350</td>
<td>0.197</td>
</tr>
<tr>
<td>Societal significance of agriculture</td>
<td></td>
<td>33.35</td>
<td>35.30</td>
<td>34.68</td>
<td>0.167</td>
<td>0.920</td>
</tr>
<tr>
<td>Production of plant products</td>
<td></td>
<td>37.45</td>
<td>29.17</td>
<td>37.04</td>
<td>2.272</td>
<td>0.321</td>
</tr>
<tr>
<td>Economic impact of agriculture</td>
<td></td>
<td>31.52</td>
<td>32.13</td>
<td>39.06</td>
<td>1.519</td>
<td>0.468</td>
</tr>
<tr>
<td>The marketing of agricultural products</td>
<td></td>
<td>29.65</td>
<td>33.52</td>
<td>39.28</td>
<td>2.119</td>
<td>0.350</td>
</tr>
<tr>
<td>The distribution of agricultural products</td>
<td></td>
<td>32.95</td>
<td>36.30</td>
<td>34.08</td>
<td>0.504</td>
<td>0.777</td>
</tr>
<tr>
<td>The global significance of agriculture</td>
<td></td>
<td>35.55</td>
<td>32.26</td>
<td>35.72</td>
<td>0.337</td>
<td>0.759</td>
</tr>
</tbody>
</table>

*Significant at the .05 level.
Table 25. Comparison of subject area knowledge mean rankings by the three panelists' occupational categories using results from the Kruskal-Wallis test

<table>
<thead>
<tr>
<th>Subject area knowledge</th>
<th>Occupational categories</th>
<th>1 Mean ranks</th>
<th>2 Mean ranks</th>
<th>3 Mean ranks</th>
<th>H-value</th>
<th>H-prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture's important relationship with the environment</td>
<td>31.85</td>
<td>35.52</td>
<td>35.68</td>
<td>0.551</td>
<td>0.759</td>
<td></td>
</tr>
<tr>
<td>The processing of agricultural products</td>
<td>38.85</td>
<td>29.33</td>
<td>35.78</td>
<td>3.336</td>
<td>0.189</td>
<td></td>
</tr>
<tr>
<td>Public agricultural policies</td>
<td>32.82</td>
<td>35.80</td>
<td>34.64</td>
<td>0.314</td>
<td>0.855</td>
<td></td>
</tr>
<tr>
<td>Agriculture's important relationship with natural resources</td>
<td>38.35</td>
<td>32.67</td>
<td>33.10</td>
<td>1.177</td>
<td>0.555</td>
<td></td>
</tr>
<tr>
<td>Production of animal products</td>
<td>27.27</td>
<td>20.64</td>
<td>22.72</td>
<td>1.913</td>
<td>0.384</td>
<td></td>
</tr>
<tr>
<td>Societal significance of agriculture</td>
<td>42.07</td>
<td>31.15</td>
<td>31.15</td>
<td>4.679</td>
<td>0.096</td>
<td></td>
</tr>
<tr>
<td>Production of plant products</td>
<td>29.13</td>
<td>29.96</td>
<td>42.98</td>
<td>7.714</td>
<td>0.021*</td>
<td></td>
</tr>
<tr>
<td>Economic impact of agriculture</td>
<td>32.80</td>
<td>34.76</td>
<td>35.62</td>
<td>0.253</td>
<td>0.881</td>
<td></td>
</tr>
<tr>
<td>The marketing of agricultural products</td>
<td>26.07</td>
<td>35.65</td>
<td>40.18</td>
<td>6.543</td>
<td>0.038*</td>
<td></td>
</tr>
<tr>
<td>The distribution of agricultural products</td>
<td>32.15</td>
<td>33.78</td>
<td>37.04</td>
<td>4.679</td>
<td>0.096</td>
<td></td>
</tr>
<tr>
<td>The global significance of agriculture</td>
<td>38.60</td>
<td>38.89</td>
<td>27.18</td>
<td>7.714</td>
<td>0.021*</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) = Agricultural industry panelists; 2 = Elementary and secondary education panelists; 3 = Higher education panelists.

*Significant at the .05 level.
did indicate a difference in the mean rank of the global significance of agriculture among the three panelists' occupational areas, the Dunn's Multicomparison Procedure was too conservative to statistically determine where the difference existed among the mean rankings of the three groups. Table 26 presents the results of this test.

Major Findings

Seventy-eight panelists submitted their definition of agricultural literacy. The conducting of quantitative analysis on those 78 definitions yielded frequencies and percentages for recurring text. Text that was present in over 25 percent of the definitions was incorporated into the group definition. In addition, the group definition also provided the 11 subject areas that fell within the framework of agricultural literacy.

Fifty-eight panelists generated concepts about agriculture that every citizen should know. A total of 590 concepts were submitted for the 11 broad agricultural subject areas. Fifty-two sub-areas of the eleven agricultural literacy subject areas emerged from the raw list of panelists' concepts. The list of concepts was refined by deleting duplicate concepts and concepts that could be combined, reducing the number of concepts to 394.

Data collected from the demographic questionnaire allowed the statistical comparison of panelists' rankings of subject area importance and subject area knowledge. The conducting of a Spearman-Rank correlation between the panelists' subject area importance rankings and
Table 26. Results of the Dunn's Multicomparsion test that determined where subject area importance or knowledge mean rankings differ among the three occupational categories

<table>
<thead>
<tr>
<th>Subject area</th>
<th>Occupational categories</th>
<th>1 vs. 2</th>
<th>1 vs. 3</th>
<th>2 vs. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>The processing of agricultural products subject area importance</td>
<td>2.253&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.036&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-2.316&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.031&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The production of plant products subject area knowledge</td>
<td>-2.236&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.029&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-2.280&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.034&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The marketing of agricultural products subject area knowledge</td>
<td>-2.378&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.026&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The global significance of agriculture subject area knowledge</td>
<td>1.925&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.081&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.050&lt;sup&gt;b&lt;/sup&gt; &lt;br&gt; 0.061&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>1 = Agriculture industry panelists; 2 = Elementary and secondary education panelists; 3 = Higher education panelists.

<sup>b</sup>P-value.

<sup>c</sup>P-probability.

*Significant at the .05 level.
subject area importance rankings found that five subject areas' importance rankings were significantly correlated with the subject knowledge rankings. They included: (1) Agriculture's important relationship with the environment; (2) the processing of agricultural products; (3) the economic impact of agriculture; (4) agriculture's important relationship with natural resources; and (5) the production of animal products. A Wilcoxon Rank Sum test was performed to determine if the mean ranking of a certain subject area importance was significantly different from the mean ranking of the corresponding subject area knowledge ranking. The pairs of rankings included: (1) the production of animal products; (2) the production of plant products; (3) the marketing of agricultural products; and (4) the global significance of agriculture.
CHAPTER V. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The central purpose of this investigation was to provide information about agricultural literacy that could assist educators in developing agricultural literacy initiatives. Data collected from a national panel were analyzed to accomplish that purpose.

This investigation was planned and conducted using the Delphi technique. Participants were nominated by agricultural education faculty of land grant universities. The intent was to identify agricultural literacy experts who would cooperate by providing their ideas about agricultural literacy. Although generalizations may not be extended to the population as a whole, this study was designed to gather information needed to further education about agriculture in this nation. The study was not designed to provide conclusions to be generalized to a broader population. However, the number of panelists involved in all phases of the study satisfactorily answered the question of process reliability. Dalkey (9) found that when the number of participants involved in a Delphi study was greater than 13, the questions of process reliability were satisfactorily answered; mean correlations were greater than .80 (see Figure 3).

Random selection of participants may not have yielded individuals who were willing to cooperate and provide the information requested. Internal validity was enhanced by asking each participant to submit the same information. These requirements limited the external validity of
the study. If a study such as this one was able to reach a reasonable sample of the population, the information provided might be different from that presented.

Although using a sample of the population for this study would increase external validity, the researcher opted to use a selected population because of the amount of time and thought that was devoted to the study by participants and the vast size of the population sample needed to conduct such a study. Generalizations from this investigation were necessarily limited to the population of panelists. Conclusions drawn may have implications for education if interpreted with a certain degree of caution.

Future researchers would be well-advised to consider the use of nonrandom samples of research such as Delphi. Discretion in the sampling procedure, random assignment, and cautious interpretation of results may enable researchers to conduct quality investigations when random sampling may prove counter productive.

The design of the study was adequate in providing the conditions necessary to accomplish the desired purpose. The group definition of agricultural literacy enabled the researcher to conduct further investigation. The 11 broad agricultural subject areas identified in the group definition were used to ask panelists to identify a concept about each of the 11 areas that every citizen should know. Reliability of the group was established by using more than thirteen panelists as suggested by Dalkey (9). The comparison of panelists' rankings of concept importance and concept knowledge gave some indication of the panelists'
opinions about the importance of different subject areas in regard to furthering agricultural literacy initiatives and indicated the knowledge the panel possessed about the 11 subject areas.

The demographic data collected indicated that the group of panelists represented three major occupational areas: (1) agriculture industry; (2) elementary and secondary education; and (3) higher education. The number of panelists from each of these groups was almost represented equally. This near equal split was not purposefully accomplished, but did add to the study by providing balanced input from three sectors of employment interested in agricultural literacy.

Communication between participants and the researcher was accomplished by letter and phone. Participant visits were not considered by the researcher because of distance, time and budgetary constraints. Although such visits may have provided additional insights, such action may have also violated internal validity assumptions.

Panelists' definitions were examined as a part of this study to determine what a large group of individual definitions had in common. A group definition was formed by using quantitative content analysis. Of the 11 broad agricultural subject areas identified in the group definition of agricultural literacy, only seven are found in the NAS Committee on Agricultural Education's definition of agricultural literacy. The NAS definition included the following subjects: (1) the economic significance of agriculture; (2) the social significance of agriculture; (3) the environmental significance of agriculture; (4 and 5) food and fiber production (this was interpreted by the researcher as
plant and animal production); (6) the processing of food and fiber; and (7) the marketing of food and fiber. The group definition provided through this investigation included four other subject areas not found in the NAS definition of agricultural literacy. The other subject areas included: (1) public agricultural policies; (2) agriculture's important relationship with natural resources; (3) the distribution of agricultural products; and (4) the global significance of agriculture. The group definition provided a psychological construct for agricultural literacy.

The concepts submitted by panelists are representative of the breadth and scope of agriculture. It was the expressed hope of the researcher to eliminate the number of concepts by asking panelists to rate the concepts generated, using preset criteria upon which to judge whether a concept would be retained or removed from the list. This was not feasible because of the large number (590) of concepts submitted by panelists. Instead, the list of concepts was reduced by the researcher. This was accomplished by gleaning duplicates and combining related concepts. Some concepts remain in more than one sub-area because they are relevant to a number of agricultural subject areas. The number of concepts was reduced by nearly 200 using this procedure. The remaining list provides educators with a comprehensive list of concepts for them to consider when pursuing their specific educational initiatives about agriculture.

Although the comparisons of panelists' rankings can only be inferred to the population of panelists, it does provide an indication of agricultural subject area importance and the subject area knowledge of
panelists. The comparison of rankings indicated the relationship and the
differences between the panelists' concept importance ranking to the
concept knowledge ranking. The results of the Spearman-Rank correlation
showed that 5 of the 11 panelists' agricultural literacy concept
importance rankings were significantly related to the respective concept
knowledge rankings. They included: (1) agriculture's important
relationship with the environment; (2) the processing of agricultural
products; (3) the economic impact of agriculture; (4) agriculture's
important relationship with natural resources; and (5) the production of
animal products. The Wilcoxon Sum Ranks test results indicated that 4 of
the 11 panelists' agricultural literacy concept importance rankings were
significantly different from the respective concept knowledge rankings.
The four pairs of rankings included: (1) the production of animal
products; (2) the production of plant products; (3) the marketing of
agricultural products; and (4) the global significance of agriculture.
The combined results of these tests found that the rankings of three
concept areas had neither a significant relationship or difference
between them. The three concept areas included: (1) public agricultural
policies; (2) the societal significance of agriculture; and (3) the
distribution of agricultural products. The rankings could be applied to
other research initiatives regarding agricultural literacy if the
purposes of the studies focused on the direction of educational
initiatives about agriculture or specifically investigated the most
important subjects and knowledge to be taught by instructors. The major
purpose of the panelists' rankings was to provide a means for panelists
to express opinions about the importance of the 11 concept areas and to rank the knowledge they possessed about the 11 concept areas.

One of the results of the NAS study was that it has focused the attention of the agricultural education profession on instruction about agriculture. The study presented a new dimension for the existence of agricultural education in this nation. Prior to the release of the study, agricultural education research was primarily directed toward the improvement of vocational agriculture programs. The NAS committee provided their definition of agricultural literacy and made recommendations. The definition that has emerged from this study is more comprehensive and, therefore, addressed one of the recommendations made by the NAS committee (45), that "the subject matter of instruction about agriculture and instruction in agriculture must be broadened." The group definition also supplied the needed agricultural literacy construct sought by researchers and educators. The panelists' agricultural literacy concepts and the subsequent refinement also addressed the NAS (45) recommendation that "the subject matter of instruction about agriculture and instruction in agriculture must be broadened." The remaining list of panelists' concepts offers those in charge of implementing agricultural literacy programs and reforming vocational agriculture programs a list of concepts from which instruction about or in agriculture could be taught.

The following conclusions were drawn from the analysis and interpretation of the data in the study:

1. Agricultural literacy describes the understanding and possession
of knowledge needed to synthesize, analyze, and communicate basic information about agriculture.

2. Agricultural literacy knowledge encompasses 11 broad agricultural subject areas which include: (1) agriculture's important relationship with the environment; (2) the processing of agricultural products; (3) public agricultural policy; (4) agriculture's important relationship with natural resources; (5) the production of animal products; (6) the societal significance of agriculture; (7) the production of plant products; (8) the economic impact of agriculture; (9) the marketing of agricultural products; (10) the distribution of agricultural products; and (11) the global significance of agriculture.

3. Fifty-two sub-areas of the 11 broad agricultural subject areas emerged as a result of the concepts submitted by panelists.

4. The agricultural literacy concepts that were generated as a result of this study demonstrated the vast amount of knowledge from other disciplines agriculture applies to produce food and fiber. The concepts also indicated how much agriculture is affected by and affects the world in which we live.

5. Comparison of panelists' rankings indicated that five concept area importance rankings were significantly related to concept knowledge rankings. Four concept area importance mean rankings were significantly different from the related concept area knowledge rankings. These rankings may only be generalized to the population of panelists.
Based on the findings and conclusion identified in this study, several recommendations were made which may impact on vocational agriculture teachers, agriculture in the classroom, coordinators, teacher educators, state supervisors, and curriculum development personnel. These recommendations were suggested in an attempt to improve the effectiveness of agricultural literacy programs throughout the nation and improve instruction about agriculture.

Curriculum materials developed should integrate applicable agricultural concepts for any subject taught at the elementary and secondary level. A number of courses could develop agricultural modules based on the concepts furnished in this study and supported by applied examples. The breadth and scope of agriculture's examples exclude few school subjects from its integration. Further refinement of the concept list by specific subject matter specialists and educators interested in incorporating aspects of agriculture into their current curriculum is advised.

The identification of where the concepts can be integrated into existing curriculum is highly recommended. Instructors need to be informed of the promise agriculture holds for their classroom in illustrating key points about human ecology and the subjects related to the agricultural food and fiber system.

The 11 broad agricultural subject areas identified in this study stretch the paradigms of educators about the use of agriculture applications that are derived from various disciplines. Instructional materials developed should represent the breadth and scope of the
agricultural discipline.

Instructional materials should be developed using a problem-solving format. Some of the materials developed about agriculture have focused on the subject matter without consideration for the learner. Future materials should provide opportunities to apply information to realistic problems. Consideration should be given to the role of the student in the learning process.

Instructor inservice should be provided to describe the intended use of instructional materials. Special summer workshops should focus on how to use the instructional materials developed in a few school subject areas rather than attempting to broadly address the needs of all subject areas. In-service education should be offered at land-grant universities so the participants can utilize the facilities available at such an institution.

The usefulness of specific instructional materials about agriculture will diminish as rapidly as the technology upon which they are based changes. Instructional materials about agriculture will only be used if quality materials can be maintained through a continuous, well-planned revision process. This will require the use of the most up-to-date educational technologies available (i.e., video discs, microcomputers, satellite hook-up, television).

A national agricultural literacy center should be established at a land grant university to administer the comprehensive development of instructional materials that can be incorporated into the elementary and secondary education curriculum. The center would be able to effectively
address the broad national recommendations of the NAS committee on agricultural education. The major responsibility of the center is envisioned as effectively keeping instructional materials up to date and addressing the new needs of instructors and students interested in learning more about agriculture.

The rapid changes in agriculture combined with our rapidly changing society present another problem. The changes that will occur make it necessary for the duplication of this study as needed. The agricultural literacy concepts submitted by panelists as a result of this study may not be relevant five years from now. Sustainable agriculture was mentioned in many of the concepts submitted, but in 1985 it probably would not have been mentioned in an agricultural concept that every citizen should know.

The group definition and concepts contribute not only to education about agriculture but also provide contemporary information for education in agriculture. The 11 broad agricultural subject areas and their concepts should prove useful in expanding agricultural education programs.
CHAPTER VI. SUMMARY

This investigation was directed toward the development of a consensus document that could provide educators with the essential concepts about agriculture that every citizen should know. Objectives for this study were identified as follows: (1) refine a group definition of agricultural literacy; (2) identify those subject areas that fall within the framework of agricultural literacy; and (3) identify those concepts about agriculture that every citizen should know.

This investigation was planned and conducted using the Delphi technique. Panelists were nominated by agricultural education faculty of land grant universities. Random selection procedures were not employed as the researcher desired to form a panel who would have the time and desire to devote to the study. Panelists were nominated by agricultural education faculty members at all but two land grant institutions.

Definitions of agricultural literacy were submitted by 78 panelists and analyzed using quantitative content analysis to form the consensus definition. Only text that was found in over 25 percent of the definitions remained in the group definition. Eleven broad agricultural areas emerged as a result of the consensus definition. In short, the group definition asserted that agricultural literacy describes the understanding and possession of knowledge needed to synthesize, analyze, and communicate basic information about agriculture. Agricultural literacy knowledge encompasses 11 broad agricultural subject areas which include: (1) agriculture's important relationship with the environment;
(2) the processing of agricultural products; (3) public agricultural policy; (4) agriculture's important relationship with natural resources; (5) the production of animal products; (6) the societal significance of agriculture; (7) the production of plant products; (8) the economic impact of agriculture; (9) the marketing of agricultural products; (10) the distribution of agricultural products; and (11) the global significance of agriculture.

Concepts about agriculture that every citizen should know were submitted for each of the 11 broad agricultural literacy areas identified in the consensus definition. This activity succeeded in producing 590 concepts from panelists. The list of concepts that encompassed the 11 broad agricultural subject areas was refined by the researcher. Refinement procedures included gleaning duplicate concepts and combining concepts that related to each other. A total of 394 concepts remained after the refinement process. Some concepts are found more than once in the comprehensive list because they were applicable to more than one agricultural subject area. Fifty-two sub-areas of the 11 broad agricultural subject areas emerged as a result of the concept submitted by panelists.

The agricultural literacy concepts that were generated as a result of this study demonstrated the vast amount of knowledge from other disciplines agriculture applies to produce food and fiber. The concepts also indicated how much agriculture is affected by and affects the world in which we live.

Panelists were asked to rank the 11 concept areas in terms of
importance to agricultural literacy initiatives and the relative knowledge they possessed about the concept areas. Comparison of panelists' rankings indicated that five concept area importance rankings were significantly related to concept knowledge rankings. Four concept area importance mean rankings were significantly different from the related concept area knowledge rankings. These rankings may only be generalized to the population of panelists.

Further refinement of the list by specific subject matter specialists and educators interested in incorporating aspects of agriculture into their current curriculum is advised.

Instructor inservice should be provided to demonstrate how agricultural literacy concepts can be applied in various school curricula. Special summer workshops should focus on how to use the instructional materials developed based on the concepts.

A national agricultural literacy center should be established at a land grant university. The major responsibility of the center would be to develop and keep instructional materials up to date and address the new needs of instructors and students interested in learning more about agriculture.

The rapid changes in agriculture combined with our rapidly changing society present another problem. The changes that will occur make it necessary for the duplication of this study as needed.

The group definition and concepts contribute not only to education about agriculture but also provide contemporary subject matter for education in agriculture. The 11 broad agricultural subject areas and
their concepts should prove useful to vocational agricultural programs attempting to reform their present curriculum.
BIBLIOGRAPHY


ACKNOWLEDGMENTS

This work is devoted to the loving memory of my grandfather, Joseph Holzinger. As an immigrant to this country, he valued education and loved agriculture with all his heart. His spirit still lives deep within me.

I would like to thank my parents, Elmer and Teresa Frick, for furnishing me with a quality education. Their sacrifices are greatly appreciated.

I would like to thank Dr. Alan A. Kahler and Dr. W. Wade Miller for their support, advice and professional guidance in my degree program. Their friendship is highly regarded.

I appreciate the friendship and assistance of many fellow graduate students. In particular, I want to recognize Mark Zidon for helping me tame WYLBR. I extend a special thank you to Dr. Sharon Drake for the opportunities she has provided me and her flexibility in arranging my work schedule.

I would like to express my appreciation to Dr. Richard I. Carter, Dr. C. Lynn Knipe, Dr. Kenneth Larson, and Dr. Anton Netusil for serving on my committee.

I want to acknowledge the work of Dr. David L. Williams in providing me with the opportunity to gain practical work experience in teacher education at Iowa State.

Most importantly, I would like to thank my wife, Shirley, and my
daughter, Emily, for their unending support and encouragement. Their love and devotion are heartily appreciated.
APPENDIX A. APPROVAL OF THE UNIVERSITY HUMAN SUBJECTS COMMITTEE
INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY
(Please follow the accompanying instructions for completing this form.)

1. Title of project (please type): Standards and Concepts of Agricultural Literacy using a National Delphi

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

Martin J. Frick 6/12/89
Typed Name of Principal Investigator  Date  Signature of Principal Investigator

3. Signatures of others (if any). Date Relationship to Principal Investigator: Co-Chairperson

6/12/89 Co-Chairperson

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects and (D) covering any topics checked below. CHECK all boxes applicable.

☐ Medical clearance necessary before subjects can participate
☐ Samples (blood, tissue, etc.) from subjects
☐ Administration of substances (foods, drugs, etc.) to subjects
☐ Physical exercise or conditioning for subjects
☐ Deception of subjects
☐ Subjects under 14 years of age and/or □ Subjects 14-17 years of age
☐ Subjects in institutions
☐ Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

☐ Signed informed consent will be obtained.
☐ Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: Month Day Year

Anticipated date for last contact with subjects:

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and/or identifiers will be removed from completed survey instruments:

Month Day Year

8. Signature of Head or Chairperson Date Department or Administrative Unit

6/12/89 Agricultural Education

9. Decision of the University Committee on the Use of Human Subjects in Research:

☐ Project Approved  □ Project not approved  □ No action required

Patricia M. Keith 6/15/89
Name of Committee Chairperson  Date  Signature of Committee Chairperson
APPENDIX B. CORRESPONDENCE
March 22, 1989

name name2
address
address2
city, state zip

Dear Dr. name2:

We are interested in determining the standards and concepts of agriculture that every agriculturally literate citizen should know about America's food and fiber system. A recent study of agricultural education by the National Academy of Science (1988) noted that "Agriculture - broadly defined - is too important a topic to the relatively small percentage of students considering careers in agriculture and pursuing vocational agriculture studies."

The method to be used in determining these standards and concepts is the Delphi technique. Delphi is a group process which utilizes written responses of experts regarding the research question. Delphi is a tool to aid understanding or decision making.

We are requesting your input in identifying those experts that would contribute their expertise and time to this process. The Delphi technique will be most effective only if qualified individuals concerned about this issue are selected as panelists. We ask that you nominate at least three individuals, not including Agricultural Education faculty, you feel are qualified to be members of this Delphi panel. The experts in this panel will remain anonymous to one another until the completion of this study.

Please complete the enclosed ballot and return in the self-addressed stamped envelope.

Your assistance in this endeavor is appreciated.

Sincerely,

Martin J. Frick, Graduate Assistant

Dr. Al Kahler, Professor

Dr. W. Wade Miller, Assoc. Professor
May 12, 1989

title name1 name2
address1
address2
city, state zip

Dear title name2:

You have been nominated by nominator to serve on a national panel to define and determine the concepts of agricultural literacy. You were nominated because of your expertise, interest in agricultural literacy, and your ability to devote time to this process.

The method to be used in determining these standards and concepts is the Delphi technique. Delphi is a group process which utilizes written responses of experts regarding questions under consideration. Over 140 experts from 47 states and the District of Columbia have been nominated to this Delphi panel. The experts on this panel will remain anonymous until the completion of the study.

Your assistance as an expert is needed for the following phases of the study:

Phase I. Defining agricultural literacy.

Phase II. Listing five (5) competencies which you believe to be essential components of each subject included in the definition from Phase I.

Phase III. Assembling responses and making minor editorial adjustments to avoid duplication of concepts which have overlaps of substance. This list will then be returned to you for your feedback.

Phase IV. Calculating frequencies for each concept under each subject area.

The tasks requested of you should not require a large amount of your time as most of the responses will be brief statements. The initial questionnaire will probably be most demanding of your time while subsequent questionnaires will be a form of feedback on concepts submitted by you and other experts. A postage paid, self-addressed envelope is enclosed for the return of your acceptance form.

Your participation in this panel is appreciated.

Sincerely,

Martin J. Frick
Graduate Assistant

Al Kahler
Professor

W. Wade Miller
Associate Professor
June 23, 1989

title name1 name2
address1
address2
city, state zip

Dear title name2:

Thank you for your willingness to participate in this study to determine the standards and concepts of agricultural literacy. The portion of the study with which you will be involved concerns the generation of a definition for agricultural literacy and the determination of standards and concepts that form the framework of agricultural literacy. The information you help generate through this National Panel will provide direction for those pursuing agricultural literacy educational initiatives.

Enclosed is a form that you may use to provide us with your definition of agricultural literacy. After defining agricultural literacy, please return the completed form in the self-addressed envelope by July 13. The return of your definition will constitute the first phase of the study.

As explained to you in our invitation letter, your assistance as a panel member is needed for four phases of the study. These phases will be carried out over the next few months. The final phase will be completed during the fall. A summary of findings will be shared with you after the four phases are complete.

Your participation in this panel is appreciated.

Sincerely,

Martin Frick
Graduate Assistant

Alan. A. Kahler
Professor

W. Wade Miller
Assoc. Professor
July 25, 1989

[Address and name]

Dear title name2:

This is a reminder that it is not too late to return your definition of agricultural literacy. You may recall an earlier mailing requesting your definition of agricultural literacy. If you have recently returned your definition please disregard this notice.

Enclosed is a form that you may use to provide us with your definition of agricultural literacy. Please return this form no later than August 18.

As explained to you in our invitation letter, your assistance as a panel member is needed for all four phases of the study. These phases will be carried out over the next few months. The final phase will be completed during the fall. A summary of findings will be shared with you after the four phases are complete.

Your continued participation in this panel is greatly appreciated.

Sincerely,

Martin Frick
Graduate Assistant

Alan A. Kahler
Professor

W. Wade Miller
Assoc. Professor
August 25, 1989

title name1 name2
address

city, state zip

Dear title name1 name2:

It is not too late to return your definition of agricultural literacy and continue participating in this important study. Your renewed participation in the study will be appreciated.

We have analyzed the content of the returned definitions and are ready to continue with the next phase of the study. The resulting definition is enclosed for your review. During this analysis, broad agricultural areas were observed in the majority of definitions. These areas are listed within the definition.

In this phase of the study, we are asking you to list the one most important concept in the space provided under each broad area listed on the enclosed sheet entitled, "AGRICULTURAL LITERACY CONCEPTS". Below your concept, please identify the specific agricultural subject area most closely related to your concept. An example of our request including the broad agricultural area, the concept inherent to that area, and the specific subject area most closely related to the concept is illustrated below. In considering the important task in front of you, we are requesting your returned responses by September 25, 1989.

We would like to take this opportunity to express our sincere appreciation for your continuous support of this study. Our next mailing will include a list of the subject areas and concepts for your ranking. Once again, thank you very much for your time and effort.

Sincerely,

Martin Frick
Graduate Assistant

Al Kahler
Professor

W. Wade Miller
Assoc. Professor
September 25, 1989

title name1 name2
address1
address2
city, state zip

Dear title name2:

If you have submitted your concepts of agricultural literacy based on the consensus definition, thank you. To those who have not returned your concepts, your continued participation in this study is needed and appreciated.

We have received feedback from panelists regarding the questionnaire on agricultural concepts. In particular, some panelists have expressed their concern over examples of concepts provided by us for your review. We admit the examples may have influenced panelists in completing the questionnaire. Therefore, we propose the following to rectify that issue:

1. Any panelist may resubmit their concepts based solely on their own interpretation, sources and experience.

2. The proceeding questionnaire will request the identification of school curriculum subject areas where each concept submitted could be introduced.

For your information, 78 panelists in 40 states are presently participating in this study.

We welcome any comments you have concerning our procedures or motives in conducting this study. Again, thank you for your support of this study.

Sincerely,

Martin J. Frick
Graduate Assistant

Alan A. Kahler
Professor

W. Wade Miller
Assoc. Professor
January 22, 1990

title name1 name2
address1
address2
city, state zip

Dear title name2:

The purpose of this letter is to inform you of the status of our agricultural literacy study that you have participated in. We received over 500 agricultural literacy concepts from 55 panelists. We felt that this large number of generated concepts would inhibit participation by panelists in further Delphi rounds.

A refined concepts list will be sent to you in the next month. Also enclosed will be a description of the methods employed to refine the generated list of concepts and a list of panel participants.

We appreciate your support of this study.

Sincerely,

Martin J. Frick, Graduate Assistant

Alan A. Kahler, Professor

W. Wade Miller, Associate Professor
APPENDIX C. PANELISTS' INFORMATION AND CONSENT FORM
I nominate the following individuals as candidates for the Agricultural Literacy Delphi panel.

NOTE: Do not nominate Agricultural Education faculty

1. NAME ____________________________________________
   ADDRESS ____________________________________________
   ____________________________________________________
   CITY ___________ STATE _________ ZIP _____
   TELEPHONE NUMBER ________________________________

2. NAME ____________________________________________
   ADDRESS ____________________________________________
   ____________________________________________________
   CITY ___________ STATE _________ ZIP _____
   TELEPHONE NUMBER ________________________________

3. NAME ____________________________________________
   ADDRESS ____________________________________________
   ____________________________________________________
   CITY ___________ STATE _________ ZIP _____
   TELEPHONE NUMBER ________________________________

Signature __________________________________________
NATIONAL AGRICULTURAL LITERACY PANEL

NOMINATION ACCEPTANCE FORM

_____ YES, I accept the nomination and look forward to serving on the national panel to define and determine the concepts of agricultural literacy.

_____ NO, At this time I am unable to accept the nomination to serve on the national panel to define and determine the concepts of agricultural literacy.

title name1 name2
address1
city, state zip

________________________________________
Signature

Thank you for your prompt return.
APPENDIX D. DATA COLLECTION INSTRUMENTS
FIRST QUESTIONNAIRE

Please submit your definition of agricultural literacy in the space provided below.

DEFINITION OF AGRICULTURAL LITERACY:

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

title name1 name2
address1

city, state zip

________________________________________
SIGNATURE
AGRICULTURAL LITERACY CONCEPTS

1. PRODUCTION OF PLANT PRODUCTS

2. PRODUCTION OF ANIMAL PRODUCTS

3. ECONOMIC IMPACT OF AGRICULTURE

4. SOCIETAL SIGNIFICANCE OF AGRICULTURE
5. THE RELATIONSHIP OF AGRICULTURE AND NATURAL RESOURCES

SPECIFIC SUBJECT AREA

6. THE RELATIONSHIP OF AGRICULTURE AND THE ENVIRONMENT

SPECIFIC SUBJECT AREA

7. THE MARKETING OF AGRICULTURAL PRODUCTS

SPECIFIC SUBJECT AREA

8. THE PROCESSING OF AGRICULTURAL PRODUCTS

SPECIFIC SUBJECT AREA
9. PUBLIC AGRICULTURAL POLICIES

10. THE GLOBAL SIGNIFICANCE OF AGRICULTURE

11. THE DISTRIBUTION OF AGRICULTURAL PRODUCTS

SIGNATURE
DEMOGRAPHIC INFORMATION

1. Male______ Female______

2. Education level: 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

3. Present Position:
   ___ Ag in the Classroom Coordinator
   ___ High School Administrator
   ___ High School Instructor
   ___ University Administrator
   ___ University Faculty
   ___ Vocational Agriculture Instructor
   ___ Former Vocational Agriculture Instructor
   ___ Farmer
   ___ State Ag. Ed. Personnel
   ___ Farm Bureau Personnel
   ___ Employed in Agribusiness
   ___ Cooperative Extension Personnel
   ___ Other: (please specify)

4. Years at present position: __________ years

5. Have you read the National Academy of Sciences report on Agricultural Education?
   ___ YES  ___ NO

6. Please rate yourself as an expert on agricultural literacy.
   expert little knowledge
   7  6  5  4  3  2  1

7. What other research do you feel would further agricultural literacy?
   (Please use the back of this sheet or separate cover for your comments.)
8. Please rank the concept areas in terms of importance to agricultural literacy (1 through 11).

___ Agriculture's important relationship with the environment
___ The processing of agricultural products
___ Public agricultural policies
___ Agriculture's important relationship with natural resources
___ Production of animal products
___ Societal significance of agriculture
___ Production of plant products
___ Economic impact of agriculture
___ The marketing of agricultural products
___ The distribution of agricultural products
___ The global significance of agriculture

9. Which of the above concept areas do you feel you possess the most knowledge about? List them in order of most to least knowledge possessed. Choose as few or many as you wish.

1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
5. __________________________________________
6. __________________________________________
7. __________________________________________
8. __________________________________________
9. __________________________________________
10. __________________________________________
11. __________________________________________
Agricultural literacy is understanding and possessing a knowledge of our food and fiber system. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture. Basic agricultural knowledge includes: the production of plant and animal products, the economic impact of agriculture, its societal significance, agriculture's important relationship with natural resources and the environment, the marketing and processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products.

FOR YOUR INFORMATION: Other topics that were noted by more than 10 percent of the time but fell below the 25th percentile included:

Careers and occupations
Nutrition and health
Biology
The science of agriculture
Agricultural management
Communication skills
The history of agriculture