Perceptions of county-level agricultural extension professionals in Iowa regarding training and informational needs in sustainable agriculture

by

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CHAPTER I. INTRODUCTION

> I am pessimistic about the human race because it is too ingenious for its own good. Our approach to nature is to beat it into submission. We would stand a better chance of survival if we accommodated ourselves to this planet and viewed it appreciatively instead of skeptically and dictatorially (E. B. White, cited in Carson, 1962, p. 1).

In agriculture, the decade of the 1960s produced the term "green revolution," and "farming systems" became the "buzz-word" of the 1970s and early 1980s. The latter 1980s and 1990s will be remembered as the era of "sustainable agriculture." The challenge of agricultural sustainability is neither new nor will it fade away into the foreseeable future (Brown, 1990). Throughout civilization, the human race has been faced with the dilemma of meeting its current needs while preserving resources for generations to come. The concept of creating a truly sustainable agriculture with its related environmental and socioeconomic concerns is a global issue. The world's natural resource base is being destroyed at alarming rates. Note the following: (1) annual global soil losses from wind and water erosion exceed 24 billion tons (Lal and Pierce, 1991); (2) decreasing and contaminated groundwater supplies; (3) the ever increasing threat of the depletion of the earth's protective ozone layer by carbon dioxide emissions; and, (4) the loss of the rainforests which is leading to increased global temperatures (Brown, 1990; National Research Council, 1989).

America currently enjoys one of the most productive agricultural systems in the world. Agriculture is our nation's largest industry with assets of $800 billion, or 17.5 percent of this country's gross national product. Some 21 million workers also make agriculture the nation's largest employer (Poincelot, 1990; National Research Council, 1989). But at what environmental and socio-economic costs have we enjoyed this success as a nation? The costs are the following: soil erosion; unsafe drinking water; and shrinking rural populations.

Soil erosion remains a serious environmental concern in many parts of the United States, even with 50 years of federal and state programs designed to control it (National Research

Council, 1989). Conservative estimates of agricultural soil loss from wind and water erosion in the United States alone range from 2.7 billion and 3.1 billion tons per year (National Research Council, 1989; Brown, 1990; Poincelot, 1990). Soil erosion is a great concern because soil reformation is extremely slow. About 500 years, with a range of 250 to 1000 years, are required to build 1 inch of topsoil (Soil Conservation Service, 1986). Unchecked erosion can result in lower crop yields as well as the loss of organic matter and the decreased capacity to retain water and essential nutrients (Poincelot, 1990). Soil erosion can also cause off-farm damage resulting in the loss of recreational value in streams and lakes, silt build-up in drainage ways, and extra costs incurred for treating drinking water. A United States Department of Agriculture (USDA) study indicated that the annual "off-site" costs of soil erosion at between $2 billion and $8 billion (USDA, 1987).

Production agriculture is also the largest nonpoint source of water contamination in America (National Research Council, 1989; Poincelot, 1990). The adequate supply of high-quality water in this country has often been taken for granted. Over 50 percent of the population in the United States use groundwater for drinking. In rural areas, nearly 100 percent of the residents drink unmonitored groundwater (Hallberg, 1987; Joint Council of Food and Agricultural Sciences, 1991). Threats to the stability of our water supply would adversely affect the future of food and agricultural production; economic stability; and the health and well-being of the nation's population (Joint Council of Food and Agricultural Sciences, 1991). Hallberg (1987) stated that rural Americans are "more dependent on groundwater than any other segment of society. Hence, the farm family perceives this problem very personally, ranking it on par with their concerns with profitability in agriculture" (Hallberg, 1987, p. 3).

The major source of the pollution of our water supply is from farm soil erosion, but inadequate management of fertilizer, irrigation runoff, and pesticides compound the problem.

Between 450 and 500 million pounds of pesticides and between 18 and 25 million tons of fertilizer are applied to row crops each year (National Research Council, 1989). Pesticides have been detected in the groundwater of 26 states as a result of agricultural practices. The highest concentrations of pesticides and fertilizers in groundwater are found in intensively farmed states, such as Iowa, Minnesota, and Ohio. A number of widely used herbicides have been detected in rivers in these states, many of which are sources of drinking water (National Research Council, 1989).

For many years now, American agriculture has unfortunately followed a trend established by industry, specialization and expansion. In agricultural terms, this trend translates into larger farming operations and fewer farmers. Between 1947 and 1985, the number of farmers fell from 10 to 2.5 million while the total harvested acres remained virtually stable at 340 million acres. This alarming statistic indicates that the average farm size has nearly tripled while displacing many farm families. Currently, 15 to 20 percent of all farms produce nearly 80 percent of all agricultural output (National Research Council, 1989).

Need for the Study

Iowa is a leading agricultural state. Its farmers produce more corn, soybeans, and swine than any other state in America (American Farm Bureau Federation, 1991). Unfortunately, Iowa also has had the dubious distinction of leading the nation in some very alarming statistics. In 1990, Iowa led the nation in herbicide use with over 46 million pounds of weed control chemicals being applied (Pins, 1991). Iowa also leads the nation in soil erosion. Iowa croplands lose approximately 240 million tons of soil annually. That is twice the national average (Soil Conservation Service, 1986). Iowa farmers spend between $300 million and $400 million each year on nitrogen fertilizers, this amount is 10 percent of all

nitrogen fertilizer sales in the United States. Of this amount, 50 percent is lost due to processes other than crop removal (A. Blackmer, personal communication, June 11, 1990).

However grim the statistics may be, Iowa has taken measures to begin to solve some of the problems facing its agricultural system. One such measure was the Iowa Groundwater Protection Act of 1987. This act of legislation led to the establishment of the Leopold Center for Sustainable Agriculture at Iowa State University. The mission of the Leopold Center is to identify and reduce adverse socioeconomic and environmental impacts of farming practices, create educational programs with the Cooperative Extension Service, and develop profitable farming systems that conserve natural resources (Iowa Groundwater Protection Act, 1987).

The Smith-Lever Act of 1914, which led to the establishment of a cooperative agricultural extension service, has perhaps made more of an impact on this nation's agricultural system than any other public organization in history (Knowles, 1980). The Cooperative Extension Service has adapted well to change in the past but it will have to continue to do so in the future or run the risk of losing its unique position of providing unbiased agricultural information and technical assistance to farmers. Evidence from a series of studies conducted in Iowa indicate that farmers are concerned about environmental problems associated with conventional agricultural practices and are vary interested in alternative production systems (Lasley and Bultena, 1986).

Agricultural extension personnel must be constantly up-dated on new developments if information regarding sustainable agriculture is to reach and be of benefit to farmers. Information regarding sustainable agricultural practices must reach those in need and be communicated in an understandable and practical form to farmers, policy-makers, and the general public. Studies have shown that Iowa farmers receive substantial amounts of information from agricultural extension professionals (Ford and Babb, 1989; Alonge, 1990; Korsching and Malia, 1991). These professionals must possess adequate training and

resources necessary to assist farmers in making value-based decisions regarding sustainable agriculture.

Purpose and Objectives of the Study

The purpose of this study was to identify and analyze the perceptions of county-level agricultural extension agents in Iowa regarding the need for additional training and informational needs in sustainable agriculture. A secondary purpose was to identify the implications of these perceptions to educational practice.

The specific objectives of this study were as follows:

1. To identify the level of importance to their work of selected topical items in sustainable agriculture as perceived by county-level agricultural extension professionals in Iowa.
2. To determine the present level of knowledge of county-level agricultural extension professionals regarding selected topical items in sustainable agriculture.
3. To identify training needs focused on sustainable agriculture of county-level agricultural extension professionals.
4. To identify the need for informational materials on selected topics in sustainable agriculture as perceived by county-level agricultural extension professionals.
5. To determine the self-perceived impact of an educational intervention related to topics in sustainable agriculture according to county-level agricultural extension professionals.
6. To compare the various groups of respondents regarding their perceptions of selected topical items in sustainable agriculture and demographic factors.

Basic Assumptions of the Study

The study was based on the following assumptions:

1. The selected topical items in sustainable agriculture represented agricultural areas of importance to the state of Iowa.
2. The respondents possessed a basic knowledge regarding the concept of sustainable agriculture.
3. The respondents would give valid and reliable information about their perceptions of sustainable agriculture.
4. The formula used to compute the training and informational need rankings was appropriate.

Operational Definitions

For the purpose of this study, the terms used have been defined as follows:

1. Administrative Area: The geopraphical location of the Iowa State University Extension administrative area in which the respondent is employed.
2. Duties: The number of additional extension responsibilities held by the respondent in addition to agricultural extension.
3. Informational materials: Any form of media, whether written or otherwise, which is intended to increase the user's knowledge of a certain topic.
4. Perception: An immediate judgement or any process of knowing facts, truths, or objects, whether by sense, thought, or by experience.
5. Sustainability: The act of prolonging or maintaining.
6. Sustainable agriculture: A system of agriculture which is environmentally sound, economically viable, and socially just and humane.

7. Technology: A system of ensuring that society has the things which it needs or desires.
8. Technology transfer: The distribution of needed or desired things to a society
9. Training: Educational programs designed to increase the profficiency of a participant on a given topic.

Implications to Extension Education

The study had implications to educational practice and agricultural extension training. An understanding of agricultural extension professionals' perception of sustainable agricultural technologies is important if appropriate training programs are to be devised to meet a major directive of the 1990 Food, Agriculture, Conservation, and Trade Act which stated that all agricultural extension personnel must have an adequate knowledge of sustainable agriculture by 1995. It was expected that the results of this study would assist extension administrators in developing inservice training programs and informational materials for agricultural extension professionals in sustainable agriculture that would in turn help farmers in acquiring relevant information and technical assistance to create a more sustainable form of agricultural production in Iowa.

CHAPTER II. REVIEW OF LITERATURE

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The specific objectives of this study were as follows: (1) To identify the level of importance to their work of selected topical items in sustainable agriculture as perceived by county-level agricultural extension professionals in Iowa. (2) To determine the present level of knowledge of county-level agricultural extension professionals in selected topical items regarding sustainable agriculture. (3) To identify training needs focused on sustainable agriculture of county-level agricultural extension professionals. (4) To identify the need for informational materials on selected topics in sustainable agriculture as perceived by county-level agricultural extension professionals. (5) To determine the self-perceived impact of an educational intervention related to topics in sustainable agriculture according to county-level agricultural extension professionals. (6) To compare the various groups of respondents regarding their perceptions of selected topical items in sustainable agriculture and demographic factors.

An extensive literature review was conducted with the goal of becoming more familiar with the research and literature related to this study. The literature review revealed a lack of research in sustainable agriculture training for extension professionals. The literature revealed that substantial research had been completed in determining the importance of sustainability to American agriculture. However, no known work was identified which dealt with the perceptions of agricultural extension professionals toward their need for additional training in issues pertaining to sustainable agriculture.

In order to assess the needs of agricultural extension professionals for training and informational needs in sustainable agriculture, it is essential to understand theories in adult education, the needs assessment process, and the concept of agricultural sustainability.

The literature review is organized under the following sub-titles:

1. Adult education.
2. Needs assessment.
3. Sustainable agriculture
4. Research related to the need for informational materials in sustainable agriculture

Adult Education

Any definition of adult learning, according to Knowles (1970) includes "an internal process of need-meeting and goal-striving by the the learner" (p. 50). An individual is motivated to engage in a learning experience to the extent that he/she has a felt need to learn and perceives that learning will help to achieve a personal goal; and the individual will invest considerable energy in utilizing available resources if he/she sees them to be relevant to his/her needs and goals (Knowles, 1970).

Love (1982) believed that "adult education is a process whereby persons who no longer attend school on a regular and full-time basis (unless full-time programs are especially designed for adults) undertake sequential and organized activities with a conscious intention of bringing about changes in information, knowledge, understanding or skill, appreciation and attitudes; or for the purpose of identifying and solving personal and community problems" (p. 22).

According to Rogers (1969), individuals have a myriad of reasons for learning:

1. Human beings have a natural potentiality for learning.
2. Significant learning takes place when the subject matter is perceived by the student as having relevance for his own purposes.

3. Learning which involves a change in self-organization--in the perception of oneself--is threatening and tends to be resisted.
4. Those learnings which are threatening to the self are more easily perceived and assimilated when external threats are at a minimum.
5. When threat to the self is low, experience can be perceived in a differentiated fashion and learning can proceed.
6. Much significant learning is acquired by doing.
7. Learning is facilitated when the student participates responsibly in the learning process.
8. Self-initiated learning which involves the whole person of the learner--feeling as well as intellect--is the most lasting and pervasive.
9. Independence, creativity, and self-reliance are all facilitated when self-criticism and self-evaluation are basic and evaluation by others is of secondary importance.
10. The most socially useful learning in the modern world is the learning of the process of learning, a continuing openness to experience and incorporation into oneself of the process of change (pp. 157-163).

Andragogy, was defined by Knowles (1970) as the "art and science of helping adults learn" (p. 38). According to Knowles (1970), the theory of andragogy is based upon four assumptions which distinguished adult learning from childhood learning: (1) as a person matures the self-concept moves from dependency toward self-direction; (2) maturity brings an accumulating reservoir of experience that becomes an increasing resource for learning; (3) as the person matures, readiness to learn is increasingly oriented towards the person's social roles; and (4) as the person matures the orientation towards learning becomes less subject-centered and increasingly problem-centered (p. 39). Adult learners are not to be viewed as acquiring information for information's sake, nor for externally imposed structures or authority

as with childhood learning. Rather, the primary direction of adult learning must be refocused to take into account the changing nature of the world and human experience. Knowles (1970) continued:

> Because an adult defines himself largely by his experience, he has a deep investment in its value. And so when he finds himself in a situation in which his experience is not being used, or its worth minimized, it is not just his experience that is being rejected--he feels rejected as a person (p. 44).

The difference between children, who are learning to be socially independent individuals, and adults, who have assumed independent decision-making roles is reflected in educational practice. Whereas the main function of childhood education is to prepare young people to function as adults through socially dictated educational standards, adult education assumes that the student is already functioning as an adult in the community and further education will assist the adult learner to realize their potential and improve their decision-making capacity (Darkenwald and Merriam, 1982).

Weinberg and Reidford (1972), in applying basic principles of humanistic psychology to education, gave five principles of learning that are highly applicable to adult education:

1. Persons learn in a free environment. The learning environment should permit and encourage self-determination and self-expression.
2. One learns by relating the world to one's experiences.
3. Persons learn , although learning cooperatively does not necessarily mean in a group. It includes constructive feedback in a noncompetitive environment.
4. Persons learn from the inside out--the learning that has the most meaning is that which is constructed from within the individual, rather than drawn from some outside force.
5. Persons learn in relation to their human qualities (Weinberg and Reidford, 1972, p. 122).

Knowles (1970) believed that there are three basic assumptions concerning learning and teaching in adult education: (1) Adults can learn - the ability to learn remains unimpaired throughout the life span. (2) Learning is an internal process - the greatest learning in adults will occur when the teaching methods and techniques allow for the individual to be most deeply in self-directed inquiry. (3) There are superior conditions of learning and principles of teaching - the most productive learning in adults will occur when the learner feels a need to learn, is taught in a comfortable environment, sees relevance in what is being taught, share in the responsibility for their learning, participates actively in the learning process, and have a sense of progress toward their goal (pp. 49-52).

Needs Assessment

The literature is replete with definitions of needs. In general, the term is used to denote a process for identifying gaps between what is and what ought to be, rank ordering those gaps, and determining which to address. In adult education, this process can yield information which can be utilized for program planning, decision-making, problem-solving, and accountability purposes (Trimby, 1979).

Sofranko and Khan (1988), in reference to extension education, offered a comprehensive definition of a needs assessment:

> Needs assessment involves a systematic approach to setting priorities and making decisions about programs and the allocation of resources. In practice it involves using people's perceptions of needs and problems, interests, and attitudes as criteria in the design of social and educational interventions (p. 14).

Knowles (1970) defined an educational need as:

> Something a person ought to learn for his own good, for the good of an organization, or for the good of society. It is the gap between his present level of competencies and a higher level required for effective performance as defined by himself, his organization, or his society (p. 85)

Kaufman and Valentine (1989) were in agreement with Trimby (1979) and posit that a needs assessment is used to identify gaps in results, places them in priority order, and then selects the most serious gap for immediate attention.

Knowles (1970) believed that there are three sources of needs and interests that must be considered in adult education program planning: (1) those of the individuals to be served; (2) those of sponsoring organizations or institutions; and (3) those of the community or society at large.

Lee and Roadman (1991) believed that there are five types of needs to consider when planning to implement a needs assessment:

1. Normative need - one which is compared to an industry standard.
2. Felt need - competencies staff feel they need to address a problem.
3. Expressed or demand need - those determined by management to increase staff effectiveness and/or efficiency.
4. Comparative need - when the performance of one division of an organization is at a lower level of productivity than other divisions which do the same work.
5. Anticipated need - when decision makers project future requirements.

Lee and Roadman (1991) stated that each of these needs must be addressed in order to arrive at a comprehensive solution to a problem. The needs assessment process must encompass all possible alternatives or risk the possibility of arriving at incorrect conclusions.

The Needs Assessment Process

The literature yields many variations of the needs assessment process. McKillip (1987, p. 9), who prefered the term "need analysis," introduced a five-step needs assessment strategy. Included in McKillip's (1987) process are the:

1. Identification of users and uses of the need analysis.

2. Description of the target population and the service environment.
3. Identification of needs - description of potential problems and possible solutions.
4. Rank ordering of the needs.
5. Communication of the results to the appropriate audience(s).

The needs assessment process, according to Austin et al. (1984), is also a five-step procedure. Their process is as follows: (1) the data gathering process; (2) the actual needs assessment; (3) a review of possible changes in the system; (4) a review of new policies and directives which have training implications; and (5) clear and concise reporting of the results.

Caffarella (1982) identified a comprehensive ten-step needs assessment process. In summary, they are:

1. Decision to undertake the needs assessment process.
2. Identification of individuals to be involved with the implementation of the needs assessment.
3. Development of focus and specific objectives.
4. Determine time frame and budget.
5. Selection of design and data collection techniques.
6. Data collection.
7. Data analysis.
8. Rank order needs.
9. From rank order, identify needs which require immediate attention.
10. Develop a plan of action to address identified needs.

Needs Assessment Models

The literature indicated the presence of four major types of needs assessment models: the discrepancy model, the marketing model, the decision-making model, and the deficiency

model. The discrepancy model is perhaps the most widely implemented type of needs assessment (McKillip, 1987). This model places an emphasis on normative expectations and consists of three phases:

1. Setting goals, determining the ideal situation.
2. Defining the present situation.
3. Identification of discrepancies, or gaps, between the goal and the present situation.

During the first phase performance goals are derived. Usually, a group of experts is surveyed to determine the performance expectations to be covered by the needs assessment procedure. The second phase examines the present situation. This is typically accomplished through the use of surveys. The third step entails measuring the gaps between what is and what ought to be. The problematic area with the widest gap is usually the first to be addressed by program planning (Trimby, 1979).

The marketing model suggests that needs assessment is tantamount to the growth and survival of an organization. McKillip (1987), citing Marti-Costa and Serrano-Garcia (1983) and Nickens et al. (1980), believed that the needs assessment process is used by organizations as an essential means of communicating with their clients. A marketing needs assessment allows an organization to adapt to the needs of its clients.

The marketing needs assessment model is based on the theory of exchange of goods and services. Needs assessment in this context is a process of determining which organizational services are desired by the target market (Kotler, 1982). McKillip (1987) described the marketing model as having three components: (1) Identification of a target audience; (2) Strategically position the organization in a competitive market, distinguished from other like organizations; (3) Develop an effective marketing mix, a wide range of quality services which will appeal to the target audience.

McKillip (1987) stated the decision-making model ranks identified needs according to the value judgement of those who will use the information, the decision-makers. The decision-making model has three steps:

1. Problem modeling, which involves the transformation of raw scores in to attribute ` scores.
2. Quantification, the decision-maker weights the attribute scores according to his/her own values.
3. Synthesis, computing an overall needs index with the highest index score being the most pressing need.

The deficiency model is a needs assessment system used to identify the root cause of problems, or the effects of the problems reduced. This model is directed more towards business and industry, but some references towards government and education have been noted (Trimby, 1979). It emphasizes decision-making based on cost-benefit analysis and is very compatible with management by objectives. The deficiency model has five steps:

1. Identification and description of the problem.
2. Hypothesize causes.
3. Test hypotheses.
4. Determine alternative solutions.
5. Evaluate the costs and benefits of each alternative.

Training Needs Assessment

Assessing the training needs of workers is an integral part of the overall staff development process. A training needs assessment is that part of the staff training program concerned with information gathering that seeks to determine an organization's changing requirements, its jobs and its employees. A training need can be seen as a gap between an

educational goal and a performance goal. Chmura (1981, p. 26) believed that there are three types of training needs to be considered:

1. A gap between actual and preferred performance that can be narrowed by training.
2. An outline of desired skills and abilities to be developed overtime to improve the performance of an organization.
3. A need that arises from a diagnosis of organizational problems for which training seen as as appropriate problem-solving strategy.

Austin et al. (1984) believed that a training needs assessment involves applying measurement tools to assess staff competence or performance, analyzing the gathered information to determine program goals and priorities, and using the training program priorities to determine training objectives, curriculum activities, and evaluation.

In an article discussing the evaluation of in-service educational programs for extension agents, Smith and Woeste (1983) stated that:

> Too little time is spent on evaluation of in-service educational programs before their implementation. Perfectly good programs may have little or no positive impact because they were not on target...they weren't what was needed to solve the problem (p. 23).

From the situation as described above by Smith and Woeste (1983), it can be assumed that the proposed beneficiaries, or recipients, of the in-service training were not involved in the needs analysis process. Many scholars agree, potential recipients must be involved in the identification of their own training needs if these programs are to achieve their stated goals (Blackburn, 1984; Roth, 1980; McKillip, 1987). Involving the recipients will have a positive influence on their motivation and commitment to participate in an in-service educational program. The participants will be actively involved and not just "going through the motions" (Blackburn, 1984; Roth, 1980). Blackburn (1984) also suggested reasons for apathy towards previous in-service programs may be discovered by involving people in their own needs assessment.

In addressing the issue of individual, or local, assessment of adult education programs, Love (1982) stated:

> The elasticity of individual adult learning needs and the fact that communal needs vary according to local circumstances mean that they must be singled out and catered to at the local level. We face a paradox. Adult education cannot flourish without some central planning and control together with a good deal of support from central funds but it also has to be tailored to actual local needs and not to assume normative needs...the problem is to not only identify prevailing needs but to anticipate changes in the social and physical environment that are bound to create new needs (p. 48).

Misanchuk (1984) identified three essential components of training needs: (1) the competence of individuals to perform a task; (2) the relevance of a skill or ability for the job role; and (3) an individual's desire to receive training.

Borich (1980, p. 39) identified a comprehensive five-step training needs assessment as follows:

1. List required competencies.
2. Survey trainees.
3. Rank order competencies.
4. Compare high priority competencies with in-service program content.
5. Revise programs or competencies.

The Borich Needs Assessment Model was designed as an alternative method of identifying appropriate inservice topics for teachers and conducting follow-up studies. The model is based upon the difference, or discrepancy, between "what is" and "what should be." Borich's model is a self-evaluative procedure which relies on the judgements of respondents about his/her own performance. The underlying assumption is, of course, that the respondent is capable of objectively evaluating their own performance. The Borich model was designed to yield readily understandable and implementable data for trainers of trainers with limited resources who need immediate feedback on the effectiveness of a program (Borich, 1980).

Barrick et al. (1983) used the Borich Needs Assessment Model to plan technical inservice workshops for vocational agriculture teachers in Ohio. Questionnaires with 12 inservice topics were mailed to 307 vocational agriculture teachers. The respondents were asked to rank the 12 topics based upon their perception of the importance, present level of knowledge, and the applicability of each topic. The topics were then ranked according to the mean ratings obtained from the survey. Two additional weighted scores were calculated. The knowledge mean was subtracted from the importance mean and multiplying the result by the importance mean to produce a weighted knowledge score and a weighted application score was calculated by subtracting the application mean from the importance mean and multiplying the result by the importance mean. The relative weighted scores were then ordered high to low. The topics with the greatest weighted scores received the highest priority for being offered as inservice courses for the vocational agriculture instructors. Barrick et al. (1983) concluded that the data from the Borich model was defensible because it takes into account a combination of two or more rankings as opposed to justifying inservice training needs based upon importance or knowledge scores alone.

A modified version of Borich's Needs Assessment Model was used by Waters and Haskell (1989) for the identification of staff development needs among extension field faculty in Nevada. The study was similar in design to that conducted by Barrick et al. (1983) with the exception that instead of basing training needs upon two weighted scores, Waters and Haskell (1989) simply added the two weighted scores together and divided their sum by 2. Their justification was that they believed that the two weighted scores should be treated equally and that it would be more convenient to use one score instead of two on which to select topics for inservice training. Waters and Haskell (1989) concluded that this particular model produced both valid and reliable results and recommended the use of this needs assessment model in determining in-service educational needs of similar groups.

Methods of Identifying Training Needs

An effective training program in any agency or organization must include a systematic means of identifying who needs to be trained and what organizational goals will be achieved if training is conducted (Chmura, 1981). Peoples' needs vary from group to group and from individual to individual and are in a constant state of change. Therefore the assessment of needs must be a continuous process if it is to allow for the dynamic nature of needs. Benseman (1980) believed that "one-shot efforts to assess needs run the risk of overlooking, to some degree at least, people's changing environment and their on-going personal development" (p. 26). Figure 1 presents Chmura's continuous training needs assessment model consisting of 5 components which include: (1) training needs assessment; (2) training priorities; (3) training design; (4) training management; and (5) training evaluation.

The five components of Chmura's model are viewed as individual steps in a cycle. The first step, a training needs assessment, leads to the identification of a set of training priorities. These training priorities, step two, lead to step three, the design of training for an organization's employees. The training must then be managed and implemented, step four. When the training is completed, the outcomes should be evaluated, step five. The evaluation then provides the basis for the next round of training (Chmura, 1981).

There is no agreement in the literature as to the most recommended method for identifying training needs. Austin et al. (1984) posit that there are four feasible methods which may be used: the nominal group technique, key informant interviews, knowledge-based surveys, and worker ability/characteristics surveys.

The nominal group technique was developed to allow for idea generation and evaluation while avoiding many of the problems of group dynamics. It usually consists of a small group of assembled for the identification of problems and the proffering of possible solutions (Delbecq, 1983; McKillip, 1987; Austin et al., 1984). The number of steps in implementing a

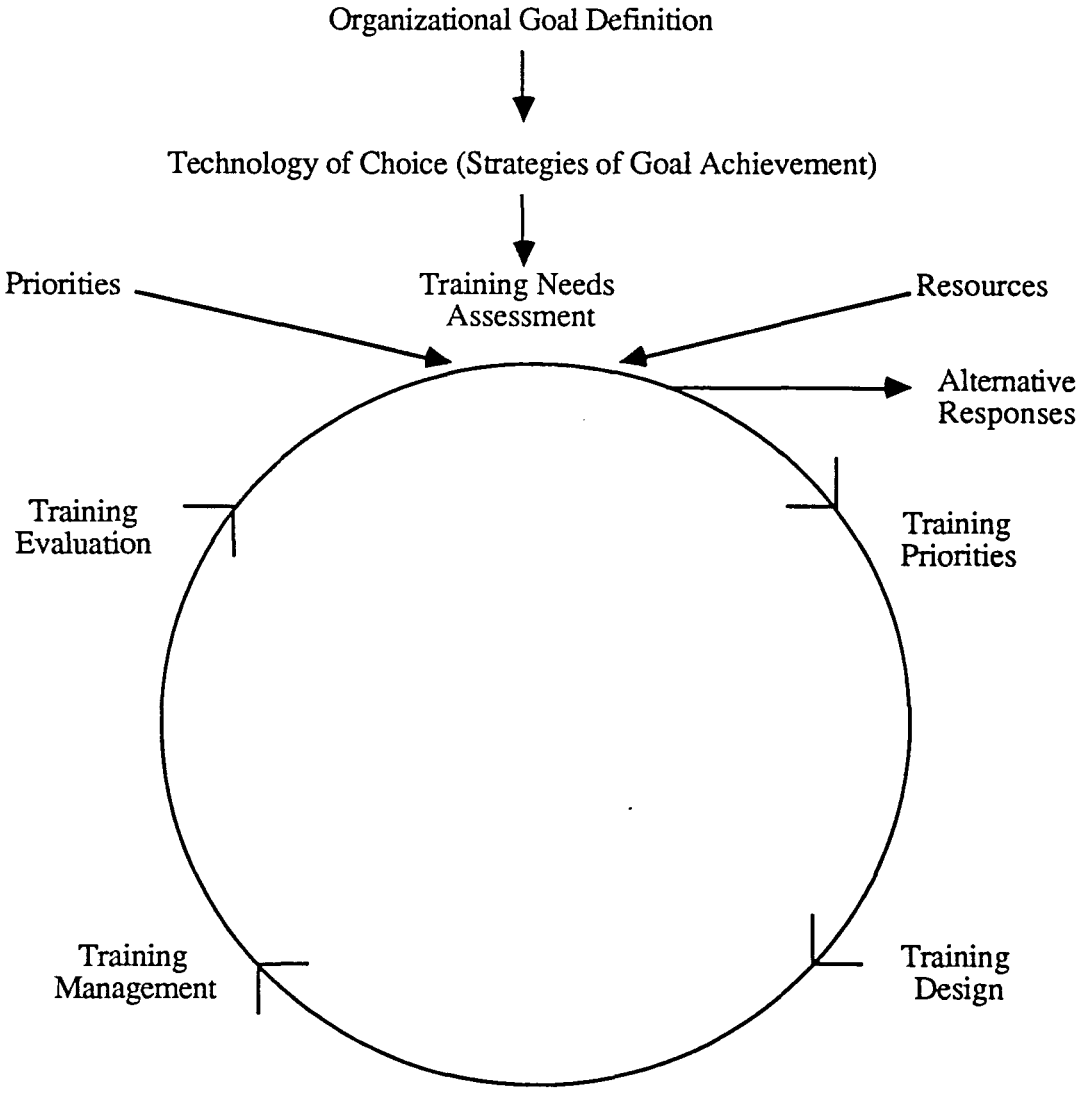

Figure 1. Chmura's Training Cycle Model (Chmura, 1981, p. 27)

nominal group technique vary from author to author. The basic steps in a nominal group technique are as follows:

1. Statement of purpose by facilitator and introduction of group members.
2. Silent generation of ideas.
3. Round-robin recording of ideas.
4. Clarification of ideas.
5. Ranking items of importance.

Key informant interviews for the identification of training needs involve the solicitation of information about organizational problems and staff training needs from individuals outside the agency who are knowledgeable about staff performance. Key informants include lawyers, judges, physicians, ministers, and other community leaders. The process usually involves the use of phone or personal interviews where the informant is asked a variety of closed and open-ended questions pertaining, but not limited, to training needs and methods, worker strengths, and organizational limitations. The negative aspect of the key informant interview, as noted by McKillip (1987), is that the informant has no organizational perspective regarding the community needs and may also be biased towards his/her own situation.

The knowledge-based method of training needs assessment is dependent upon staff self-reports comparing themselves to a list of competencies considered necessary to perform required tasks (Austin et al., 1984 and Borich, 1980). Using these self-reports, a training needs survey is compiled and distributed to the staff with the underlying assumption that the employees are able to identify those knowledge areas essential for job performance. It is a simple method to implement and can bring quick results.

McKillip (1984, p. 77) described a complete four-step staff training needs analysis survey as follows:

1. Potential training topics are identified.

2. Survey potential trainees and ask each to rate each training topic based on: the level of competence of current job holders (what is); the relevance of the training topic to the job (what should be); and the employee's interest in the training topic (desire)
3. Training areas receiving a high mean rating on relevance and low mean rating on competence are identified as essential training needs.
4. The selection of training areas based on respondents' desire and cost-benefit analysis of the selected topics.

According to Austin et al. (1984), the worker ability/characteristic approach to training needs assessment is based on the identification of factors which hinder job performance. Surveys containing worker ability and personal characteristic statements identify training needs by describing the level of worker hindrance for each statement. The main strength of this method is that it addresses three skill areas: interpersonal, process, and knowledge application. Austin et al. (1984) concluded:

> Because the worker ability/characteristic method is focused on job hindrance and not training "wants," it provides a direct indication of those worker abilities where a lack of knowledge or skill has limited the capacity of the worker to perform the job (p. 114).

A negative aspect of the worker ability/characteristic needs assessment method is that worker ratings may be biased towards the norms of the organization. This problem can be remedied by the use of anonymous reporting and the possible use of social desirability scales (Austin et al., 1984).

Sustainable Agriculture

What is sustainable agriculture? What constitutes a system of agriculture to be sustainable? The literature indicates that there are as many definitions of the term as there are sources. There is also confusion over the definition because of the variety of terms used to describe the concept of agricultural sustainability. These terms include, but are not limited to,

"low-input sustainable agriculture (LISA), " "alternative agriculture," "organic farming," "regenerative farming," and "best management practices" (Keeney, 1989).

Defining Sustainable Agriculture

Berry (1977) proffered a simplistic and broadly-based definition of the term as he believes that a sustainable agriculture is one which does not deplete soils or the land. The definitions of other authors are somewhat more explicit. The paragraphs that follow provide an overview of selected definitions of the concept of agricultural sustainability.

Fisher (1982) believed that there are eight basic components which are required for the achievement of a sustainable agriculture system:

1. Dynamism. In biological systems, that which is static is rarely sustainable.
2. A sustainable system of agriculture must be one that achieves the production of crops and livestock and the management of the farm's resources in a way that harmonizes rather than conflicts with natural systems.
3. The system must be diverse in order to achieve optimum production.
4. It must rely primarily on renewable resources for the achievement and maintenance of basic soil fertility.
5. The system must be one in which the input of thought, ingenuity, care, and personal involvement can be judged to be more significant than the inputs of technology.
6. A system of sustainable agriculture should be one which recognizes the contribution of good nutrition to the health of populations and accepts that the producer has a special responsibility to ensure that he or she eliminates the hazards of toxicity.
7. Sustainability must embrace more than crops, livestock, and the soils which support their production. It must also include the people who work or live on the land, and the relationship of the land to the rest of the rural community in which it is situated.

8. A farming system is more likely to be sustainable if it aesthetically pleasing to those who work on or live near it, and if it enhances rather than scars the landscape of which it forms a part. Individually and collectively, we are more likely to help sustain that which pleases rather than disturbs us (Fisher, 1982, pp. 25-26).

Rees (1990, p. 27), an economist, believed that "true sustainability requires that we recognize the the reality of ecological limits to material growth and the need to live on the interest of our remaining ecological capital."

Bidwell (1986) took a somewhat more radical approach to agricultural sustainability. He believed that agricultural systems must be run on renewable energy such as the sun. Bidwell agrued that his idea is no more ridiculous than conventional agriculture's paradigm of "strength through exhaustion" (p. 317). He goes on to state that "America's use of three calories of energy to produce one calorie of food for domestic consumption not only is unsustainable but wasteful, selfish, and immoral" (Bidwell, 1986, p. 317). Jackson (1980), who also took a radical stance, promoted a small farm sustainable agriculture system based on high-yielding perennial grain crops. But Jackson (1980) was also realistic as he believed an agriculture based on perennial grains would involve complex economic, social, and cultural changes.

Francis et al. (1988) defined a sustainable agriculture system as being:

> A management strategy which helps the producer to choose hybrids and varieties, soil fertility programs, and the cultural practice package including rotations, tillage and crop sequences to reduce costs of purchased inputs, minimize the impact of the system on the immediate and the off-farm environment, and provide a sustained level of production and profit from farming (p. 123)

Whereas Keeney (1989) used a working definition which includes:

> ...agricultural systems that are environmentally sound, profitable, and productive and that maintain the social fabric of the rural community (p. 102).

Lockeretz (1988) stated that the goals of sustainable agriculture are to:

> ...return a profit, decrease harm to the environment and to personal health, and provide a basis for a sustainable community by offering a way for people to stay on the land and be less dependent on federal payments for their livelihood (p. 175)

Benbrook (1989) and the National Research Council (1989) used the term "alternative agriculture" to describe a eclectic agricultural system which promotes sustainability:

> Alternative agriculture is a system of food or fiber production that systematically pursues the following goals: Nutrient cycling, integrated pest management, greater productive use of biological and genetic resources, better match in cropping patterns and the physical limitations of available resources, and profitable and efficient production (p. 154).

The key components of "alternative agriculture," according to the National Research Council (1989), is any system of agriculture that includes the following goals:

1. More thorough incorporation of natural processes such as nutrient cycles, nitrogen fixation, and pest-predator relationships into the agricultural production process.
2. Reduction in the use of off-farm inputs with the greatest potential to harm the environment or the health of farmers and consumers.
3. Greater productive use of the biological and genetic potential of plant and animal species.
4. Improvement of the match between cropping patterns and the productive potential and physical limitations of agricultural lands to ensure long-term sustainability of current production levels.
5. Profitable and efficient production with emphasis on improved farm management and conservation of soil, water, energy, and biological resources (p. 27).

Lee and Buam (1989) made the assumption that low-input sustainable agriculture (LISA) refers to a system of management practices that minimize environmental destruction, and that rely on less intensive and more effective use of soil and water resources. However, it is believed that "LISA" does not refer to low technology agriculture as research over the coming decades in intensive management strategies and biotechnology will lead to successful global adoption of low-input sustainable agricultural practices (Lee and Baum, 1989).

Congress, in the enactment of the Food, Agriculture, Conservation, and Trade Act of 1990, adopted perhaps the most all-encompassing definition of sustainable agriculture as they believed it to be:

> ...an integrated system of plant and animal production practices having a site-specific application that will, over the long term, satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agricultural economy depends; make the most efficient use of nonrenewable resources and onfarm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole (Public Law 101-624).

Anderson and Lockeretz (1992), in a study of self-labeled sustainable agriculture research projects, found that of the 122 projects which responded, almost all covered techniques that have the potential to conserve nonrenewable resources and reduce environmental pollution. However, they did not show the scope that current writing about sustainable agriculture emphasizes--only 22 percent focused on entire farming systems, 25 percent looked at integrated crops and livestock, 19 percent examined general processes from which agroecological principles could be learned, 44 percent measured environmental effects, and 7 percent studied off-farm social and economic effects. Anderson and Lockeretz (1992) found that projects conducted cooperatively between experiment stations or private research organizations and commercial farms were more likely to study entire farming systems, interactions of crops and livestock, and off-farm social and economic effects more than studies conducted entirely at experiment stations.

The precise definition of sustainable agriculture is far less important than the ethical commitment to the land that emanates through all the terms that have been used. Throughout the discussion of definitions of sustainable agriculture, the theme which seems to underpin the concept is a system which promotes agricultural practices that are environmentally sound, economically viable, and socially just and humane.

Barriers to Agricultural Sustainability

Kirschenmann (1990) believed that establishing a sustainable agriculture will not be as easy as "exchanging chemicals for legumes, and crop rotations for monocropping practices" (p. 123). Agricultural sustainability can not be promoted when social and economic policies promote non-sustainable lifestyles and economic growth. Kirschenmann (1990) stated that a sustainable system of agriculture will not become a reality as long as we:

1. ...have trade policies that encourage cropping systems that result in annual, global soil losses of 25 billion tons of topsoil.
2. ...have social policies that annually add 90 million new citizens to the planet while discouraging land and trade reforms that would enable indigenous people everywhere to feed themselves.
3. ...have energy policies that continue to encourage the use of fossil fuels whose carbon dioxide emissions are producing global warming.
4. ...have economic policies that squeeze farmers between two highly organized and highly leveraged economic enterprises (farm supply manufactures and money suppliers on the one hand, and the commodity trade and processing industry on the other), sustainable farmers can never compete successfully in that clientele and will therefore always be forced to mine the environment to survive.
5. ...have investment policies that allow farmland to be traded as an investment commodity, such that wealth, rather than land wisdom, is the principle criterion for land ownership.
6. ...continue to support policies based on the presumption that the road to recovery for agriculture lies in getting rid of more farms and farmers (pp. 124-125).

Poincelot (1986) strongly supported the position taken by Kirschenmann (1990) regarding barriers to agricultural sustainability. Poincelot (1986) argued that public consciousness must be raised about the failure to move toward a more sustainable agriculture.

> Once the specter of food shortages, food priced out of the reach of many, and the possibility of strife and war brought on by impending starvation is realized, the public will support more agricultural funding. The present image of a hugely successful American agriculture will be difficult to overcome, but it must be done (Poincelot, 1986, p. 10).

Kirschenmann (1990), the National Research Council (1989), Granatstein (1988), and Poincelot (1986) all believed that the reason for many of the barriers to agricultural sustainability lie in the fact that we, as a nation, have never had clearly defined long-range national goals for agriculture. Many programs, such as soil conservation and export policies, have had conflicting objectives (National Research Council, 1989). Conservation programs have called for the preservation of natural resources, while commodity programs have forced farmers to push these resources to their biological limits (Granatstein, 1988). According to Kirschenmann (1990), the logical first step would be to develop coordinated national priorities that would guide policy making activities towards the end goal of agricultural sustainability.

Governmental Policies Concerning Sustainable Agriculture

In reporting what it deemed to be the national priorities for research, extension, and higher education in the United States to the Secretary of Agriculture, The Joint Council of Food and Agricultural Sciences (1991) developed a list of twenty-one items which need urgent attention. Topping the list of recommendations made to the Secretary of Agriculture was the goal of attaining agricultural systems that are compatible with environmental and social values. The specific objectives of their goal were:

1. Protect and improve water quality and quantity.
2. Develop environmentally safe agriculture and natural resource systems.

3. Ensure safe and effective management of pests,
4. Sustain natural resource productivity.
5. Pursue genome mapping and genetic enhancement.
6. Maintain animal health and welfare.
7. Promote waste management and use.
8. Understand impacts of global environmental change.

A provision for sustainable agriculture was a major initiative of the Food, Agriculture, Conservation, and Trade Act of 1990. The purpose of the sustainable agriculture initiative adopted by Congress was to encourage research designed to increase the body of knowledge concerning agricultural production systems.

The specific objectives of the sustainable agriculture initiative were:

1. To maintain and enhance the quality and productivity of the soil.
2. To conserve soil, water, energy, and natural resources, and fish and wildlife habitat.
3. To maintain and enhance the quality of surface and groundwater.
4. To protect the health and safety of farmers, farmworkers, and consumers.
5. To promote the well-being of animals.
6. To maintain or increase the number of economically viable self-employment opportunities in agriculture.

In Chapter 3, Sustainable Agriculture Technology Development and Transfer Programs, of Sub-title B (Research) of the Food, Agriculture, Conservation, and Trade Act of 1990, Congress directed the USDA to develop technical and educational material that provides a description of farming production systems that promote agricultural sustainability. Practical sources of information are to be developed to assist farm operators in the selection of appropriate crops, rotation practices, tillage systems, nutrient management systems, soil

building practices, integrated pest management systems, soil, water, and energy conservation, and livestock management (Public Law 101-624, 1990).

Chapter 3 also includes provisions for education and training of extension agents and other professionals involved in the education and transfer of sustainable agriculture technologies. Regional training centers will be designated at existing institutions to provide intensive training for agricultural extension personnel. A provision was also made for the awarding of competitive grants to institutions to conduct workshops to familiarize other extension personnel with the concept of sustainable agriculture. According to Chapter 3, all agricultural extension professionals are to receive training in sustainable agriculture no later than 1995. Agricultural extension personnel hired after 1993 will be required to demonstrate a thorough knowledge of sustainable agriculture and integrated crop management within 18 months of employment (Public Law 101-624, 1990).

The Food, Agriculture, Conservation, and Trade Act of 1990 also directed the Cooperative Extension Service in each state to coordinate the transfer of information that will: (1) facilitate the development of farmer-to-farmer information exchange networks; (2) assist in the coordination of regular farm tours and field days; (3) be used for planning extension programs related to sustainable agriculture; (4) provide technical assistance to farmers making a transition to sustainable agricultural systems; (5) enable the Cooperative Extension Service to work in concert with the Soil Conservation Service and the Agricultural Stabilization and Conservation Service; (6) develop specific programs in areas susceptible to groundwater contamination; (7) establish information related to agricultural diversification; (8) develop a program to increase the awareness of the importance of well-water testing; (9) disseminate specific information on water quality practices; (10) provide specific information related to nutrient management; and (11) develop integrated farm management systems (Public Law 101-624, 1990).

Research Related to the Need for Informational Materials in Sustainable Agriculture

Although the purpose of this study was to identify the training and informational needs of county-level extension professionals regarding sustainable agriculture, the needs of the farmer relating to agricultural sustainability must also be addressed. A mail survey of 269 Iowa farmers with membership in the Practical Farmers of Iowa, a sustainable agriculture organization, by Korsching and Malia (1991), was used to examine perceptions of institutional support for information on sustainable agriculture. They concluded that traditional sources on farming practices, such as the extension service, were not considered to be credible sources of information for sustainable agricultural practices. They went on to state:

> If the extension service and other such organizations want to become important information sources on sustainable farming, they will need to expend more resources and to develop strong programs in this area to gain credibility among sustainable farmers (Korsching and Malia, 1991, p. 21).

Research by Alonge (1990) supported the findings of Korsching and Malia (1991). In a study conducted to identify perceptions held by selected members of the Iowa Young Farmer Education Association, Inc. regarding the profitability, compatibility, and complexity of selected low-input sustainable agricultural practices, Alonge (1990) reported that over one-half of the responding farmers were adequately informed about the benefits of adopting sustainable agriculture practices. However, Alonge (1990) found that most of the information was obtained from the mass media and agricultural businesses as opposed to more traditional institutional contacts such as the Cooperative Extension Service, Soil Conservation Service, and Soil and Water Conservation District Commissioners. Alonge (1990) found that respondents rated the information which was provided by Cooperative Extension Service, Soil Conservation Service, and Soil and Water Conservation District Commissioners as either being useful or very useful but still lower than the usefulness ratings given to the information provided by mass media and agricultural businesses.

The findings of Alonge (1990) are very much in agreement with those of a study undertaken by the USDA in 1980 of organic farmers concerning the role of extension in providing information to regarding alternative agricultural practices. USDA (1980) reported that 25 percent of the respondents indicated that organic farmers did not perceive the universities or Cooperative Extension Service as either being willing or able to provide them with assistance. A major recommendation of their study was that informational materials needed to be developed for county extension agents to assist them in providing services needed by organic farmers (USDA, 1980).

A study done by Ford and Babb (1989) to determine the sources and uses of information of farmers in Indiana, Iowa, Georgia, and Illinois indicated farm magazines, the county extension agents, and other farmers were the most frequently used sources of information for making nine farm decisions. However, their study found that the Cooperative Extension Service and Soil Conservation Service were not widely used by the farmers surveyed. Less than one-half of the total responses indicated the use of public sources of information. Only the crop planting decision and the Conservation Reserve program decision approached the 50 percent level with 29.4 percent and 40.6 percent, respectively. Decisions related to farm economics were assisted exclusively with information provided by private sources. Ford and Babb (1989) suggested that if farmers continue to seek economic advice from private sources it is then important for the Cooperative Extension Service to ensure that agribusiness professionals are kept well informed of new agricultural innovations.

In their conclusion, Ford and Babb (1989) recommended that:

> The extension service and university research systems must continue to develop and provide information for which there is no economic incentive to develop in the private sector. The large resource base in the university/extension system and its associated economies coupled with impartiality and responsiveness to farm needs means that the public sector will continue to lead in developing information for: current crises, such as recent droughts; government programs, such as CRP; and new technology, such as low-input, sustainable agriculture (p. 475).

CHAPTER III. METHODS AND PROCEDURES

The purpose of this chapter is to discuss the methods and procedures used to conduct this study. After a review of the purpose, design, population, instrumentation, data collection, and data analysis will be presented.

Purpose of the Study

The purpose of this study was to identify and analyze the perceptions of county-level agricultural extension agents in Iowa regarding the need for additional training and informational needs in sustainable agriculture. A secondary purpose was to identify the implications of these perceptions to educational practice.

The specific objectives of this study were as follows:

1. To identify the level of importance to their work of selected topical items in sustainable agriculture as perceived by county-level agricultural extension professionals in Iowa.
2. To determine the present level of knowledge of county-level agricultural extension professionals in selected topical items regarding sustainable agriculture.
3. To identify training needs focused on sustainable agriculture of county-level agricultural extension professionals.
4. To identify the need for informational materials on selected topics in sustainable agriculture as perceived by county-level agricultural extension professionals.
5. To determine whether attending workshops or conferences in sustainable agriculture has had an impact on the perceptions of county-level agricultural extension professionals regarding their perceived level of importance, present knowledge, need for additional training, and need for informational materials in sustainable agriculture.

6. To compare the various groups of respondents regarding their perceptions of selected topical items in sustainable agriculture and demographic factors.

Research Design

The study adopted a descriptive survey design. This design was deemed appropriate given the exploratory nature of the data to be collected. Descriptive research is used to obtain information about the nature, incidence, or distribution of education variables and/or the relationships among these variables (Ary, Jacobs, and Razavieh, 1990). Descriptive studies attempt to describe the situation as it exists at the time of the research.

Population

The target population for this study consisted of all county-level agricultural extension professionals in the Iowa State University Extension Service.

Since the target population for this study consisted of all agricultural extension professionals, it was possible to reach the entire population, no specific sampling technique was required. Subjects were indentified for participation through a current listing of all county-level agricultural extension personnel secured by the reseacher from the Iowa State Cooperative Extension personnel office. Ninety-one agricultural extension professionals qualified for this study.

Instrument Development

A mailed questionnaire was chosen by the researcher as the data collection instrument. Several questionnaires were examined from other studies of similar design to assist the researcher in developing a questionnaire best suited for this particular study. The instrument designed by the researcher focused on training and informational needs of county-level

agricultural extension professionals regarding topical areas associated with sustainable agriculture. The selection of the topical areas in sustainable agriculture was based on a comprehensive review of the literature, experiences of the researcher, and suggestions from Iowa State University Extension and Soil Conservation Service personnel.

The questionnaire consisted of three sections. In section one, the respondents were asked to indicate their perceptions of the importance to their work and their present level of knowledge regarding forty-three topical areas associated with sustainable agriculture. In section two, the respondents were asked to indicate their perceptions of the need for additional training and informational materials in each of the forty-three items. Section three consisted of nine questions designed to obtain demographic information and other data from the repondents.

In section one, respondents were asked to use a 5-point Likert-type scale (1-5) to indicate their perception of the importance of the topical areas to their work and their present level of knowledge. Descriptors of the scale were as follows: 1 = none, 2 = very little, 3 = some, 4 = moderate, and 5 = high.

Section two also used a 5-point Likert-type scale (1-5) to evaluate the response of the participants to questions regarding the need for additional training and need for informational materials in sustainable agriculture. Descriptors of the scale were as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

In order to establish content validity, the instrument (Appendix A) was reviewed by the researcher, major professor, four professors from the department of Agricultural Education and Studies, an associate director of the Leopold Center for Sustainable Agriculture, two State Resource Conservationists with the Soil Conservation Service, the Iowa State University Extension Coordinator for Practical Farmers of Iowa, an Iowa State University Extension Area Crops Specialist, and graduate students in the department of Agricultural Education and Studies. They examined the instrument for instructions, content of the items, validity of scales used, and

made comments to help improve any vague or unclear items. Several modifications were suggested and made. After revising the questionnaire, the instrument and relevant documentation were submitted to and approved by the Human Subjects Committee at Iowa State University (Appendix A).

Data Collection

Data collection was accomplished through the use of a mailed questionnaire. A cover letter (Appendix A) was attached to the coded questionnaire, and a self-addressed prepaid return envelope was mailed to the participants. The letter explained the purpose and the need for the study and asked for the voluntary cooperation of the respondents.

Participants were mailed the questionnaire during the first week of December, 1991. The first mailing brought a response of 70 questionnaires. A follow-up post card (Appendix B) was sent to the 21 non-respondents during the third week of December, 1991. A total of 83 questionnaires were returned, representing a response rate of 91 percent. Of the 83 returned questionnaires, 80 were usable, giving a usable response rate of 88 percent.

Data Analysis

The data collected from the respondents were checked and coded by the investigator then entered and analyzed using the facilities of the Iowa State University Computation Center.

The anlaysis of the data was as follows:

1. The Statistical Package for the Social Sciences (SPSS) program and subprograms were used to analyze the collected data.
2. The subprogram FREQUENCIES was used to analyze means, standard deviations, frequency counts, and percentages.

3. The subprogram RELIABILITY was used to determine a Cronbach's alpha to test the internal consistency of the grouped items in the data collection instrument.
4. The subprogram ONEWAY was used to determine if significant differences existed in the perceptions of respondents grouped by various demographic variables. The Scheffe test was performed to locate the sources of the differences when significance (0.05) was found.
3. The subprogram T-TEST GROUPS was used to determine which of the mean values related to the respondent's perceptions were significantly different between agricultural extension professionals who had and had not previously attended workshops or conferences on the topic of sustainable agriculture. The 0.05 level of significance was used as a basis for determining significant differences among means
5. COMPUTE statements were used to formulate a score by which to prioritize the various items on the need for training and informational materials. The equations developed with COMPUTE statements were as follows:

$$\frac{[(ITW - PLK) \times ITW] + NAT}{2} = \text{Need for additional training score}$$

$$\frac{[(ITW - PLK) \times ITW] + INFO}{2} = \text{Need for informational materials score}$$

ITW = Importance to work

PLK = Present level of knowledge

NAT = Need for additional training

INFO = Need for informational materials.

6. Subprogram CORRELATIONS was used to check the relationship of ranked items to determine the relationships among them. If the correlation between any two of the scores is high, the logic of using both scores as criteria for determining need will not be supported. If correlations are low to moderate, each score should be used in the process of rank ordering the topics (Waters and Haskell, 1989).
7. Subprogram REGRESSION was utilized to further validate the results of this study. The relationships among the four sets of scores were explored further to determine if the addition of the importance to work scores and present level of knowledge scores is contributing anything to the needs assessment model above and beyond the information gained by asking the respondent to rate each of the selected topical items in sustainable agriculture based solely on their perceived needs for additional training and for informational materials. If most of the variance in the two needs scores could be explained by the combined variance of the importance to work scores and present level of knowledge scores, there would be no logic in using these additional scores to determine additional training and informational material needs of the respondents in sustainable agriculture since additional training needs scores and informational material scores would be adequately represent the other two scores (Waters and Haskell, 1989).

Limitations

Information gained from this study was limited to and assumed to represent only the county-level agricultural extension professionals in Iowa provided in a listed shared with the researcher by the Iowa State University Extension personnel office.

CHAPTER IV. FINDINGS

The purpose of this study was to identify and analyze the perceptions of county-level agricultural extension agents in Iowa regarding the need for additional training and informational needs in sustainable agriculture. A secondary purpose was to identify the implications of these perceptions to educational practice.

This chapter presents the results obtained from the statistical analysis of the data. This chapter also contains a compilation of comments made by the participants in the study. The chapter is divided into the following sections: (1) Reliability Tests; (2) Demographic Information; (3) Perceptions of Respondents Regarding the Importance of Sustainable Agriculture Items; (4) Perceptions Regarding Present Level of Knowledge; (5) Perceptions Regarding the Need for Additional Training; (6) Perceptions of Respondents Regarding the Need for Informational Materials; (7) Overall Priority Rankings of Training and Informational Material Needs; and (8) Comments Made by Respondents.

Reliability Tests

To examine the level of internal consistency and stability of the items related to sustainable agriculture in the instrument, Cronbach's Alpha procedure was used. Results of the reliability tests are presented in Table 1. The overall reliability of the instrument was determined to be .9738. The alpha coefficient was computed for the 43 items in each of the following areas: Importance to work; present level of knowledge; need for additional training; and need for informational materials. The coefficients for the four areas ranged from .9477 to .9566. The coefficient values were deemed to be sufficiently high to proceed with analysis and interpretation of the data. According to Nunnally (1982), a minimum alpha coefficient of 0.65 is recommended for educational research purposes. Table 1 shows the results of the reliability

Table 1. Results of reliability tests for the instrument sections

Sections	Number of items in section	Cronbach's alpha coefficient
Importance to work	43	.9477
Present level of knowledge	43	.9566
Need for additional training	43	.9540
Need for informational materials	43	.9500
Total	172	.9738

tests for instrument on perceptions of importance to work items, present level of knowledge items, training need items, and informational need items.

Demographic Information

This section describes the demographic characteristics of the county-level agricultural extension agents in Iowa. Ninety-one questionnaires were mailed to the selected participants, and 80 usable questionnaires were received. A question asking the gender of the respondent has been omitted in the data analysis because all of the respondents were male.

The distribution of respondents by age is presented in Figure 2. Twenty-three (28.75%) respondents reported an age between 30 and 39 years; 20 (25%) respondents reported an age between 40 and 49 years; 27 (33.75%) respondents reported an age between 50 and 59; 7 (8.75%) respondents reported an age of 60 or older. There were three (3.7%) respondents who chose not to disclose their age. The age distribution of the respondents indicates that over 90 percent of the respondents were between the ages of 30 and 59 years. Over 33 percent of the respondents were between the ages of 50 and 59 years. The smallest age group was the respondents reporting their age to be 60 years of age with nearly 9 percent.

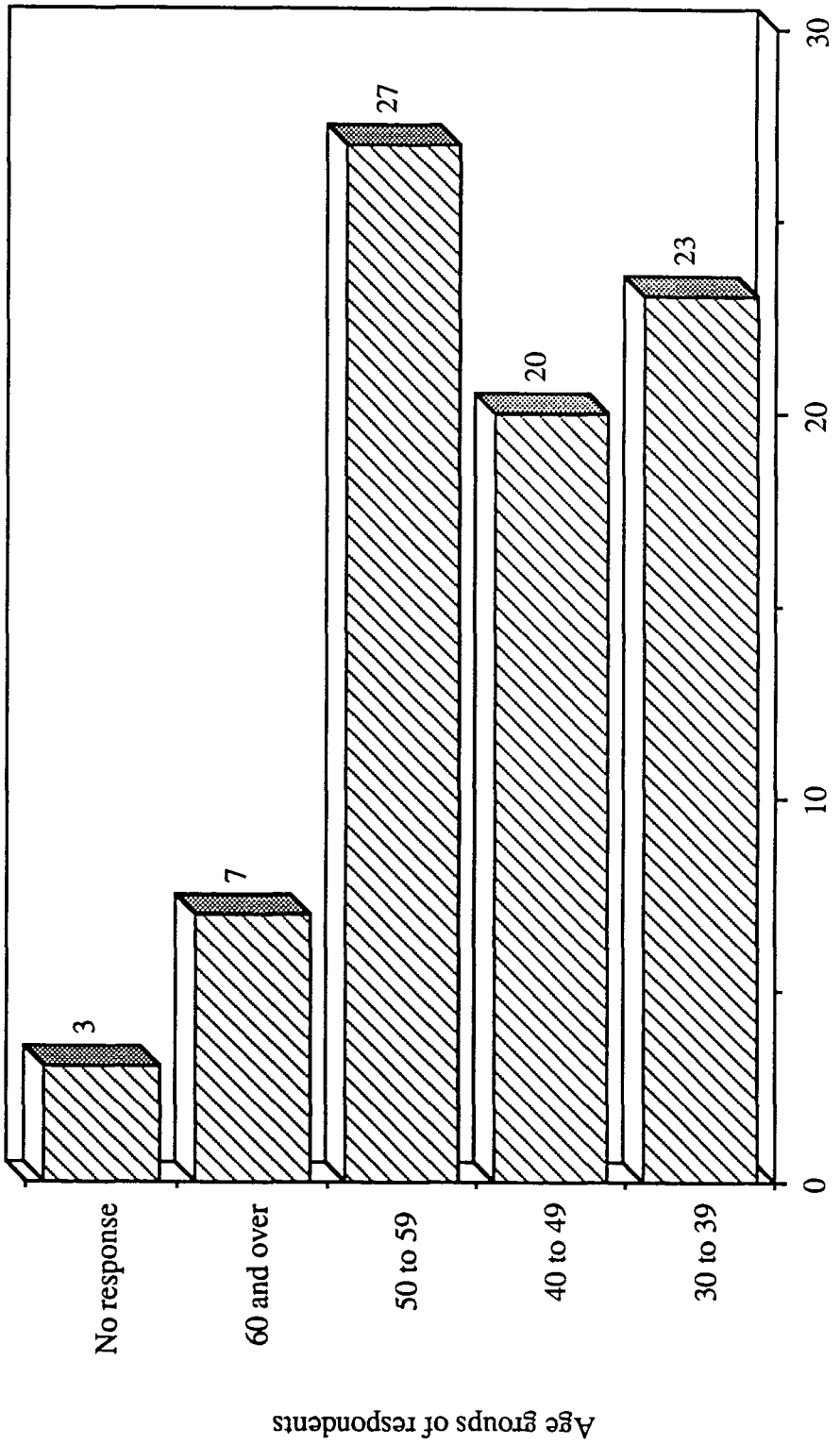

Figure 2. Distribution of respondents by age (n = 80)

The distribution of respondents by the number of years they had been employed by Iowa State University Extension is represented in Figure 3. 29 (36.25%) respondents had been employed between 1 and 9 years; 17 (21.25%) respondents had been employed between 10 and 19 years; 21 (26.25%) respondents had been employed between 20 and 29 years; 12 (15%) respondents had been employed for more than 30 years. There was only 1 (1.25%) respondent who chose not to disclose the number of years they had been employed to the investigator. The years of employment distribution of the respondents indicates that over 57 percent of the respondents had been employed between 1 and 19 years. Over 26 percent of the respondents had been employed between 20 and 29 years. Only 15 percent of the respondents reported being employed by Iowa State University Extension for more than 30 years.

The distribution of respondents by administrative area is presented in Figure 4. Of the respondents contacted in the seven extension administrative areas, 15 (18.8%) of the respondents were from the Southwest Area; 9 (11.2%) of the respondents were from the East Central Area; 9 (11.2%) of the respondents were from the Central Area; 14 (17.5%) of the respondents were from the North Central Area; 9 (11.2%) of the respondents were from the Southeast Area; 13 (16.2%) of the respondents were from the Northwest Area; and 11 (13.7%) of the respondents were from the Northeast Area.

The distribution of respondents by their highest level of education achieved is presented in Figure 5. The data indicated that 19 (23.7%) of the respondents had completed a bachelor's degree; 58 (72.5%) of the respondents had completed a master's degree; and 2 (2.5%) of the respondents had completed a doctoral degree. Only 1 (1.2%) respondent chose not to disclose his highest level of education achieved.

The distribution of respondents by their major area of study for their highest level of education achieved is presented in Figure 6. Thirty-five (43.8%) of the respondents indicated a major in education (agricultural education, agricultural and extension education, extension

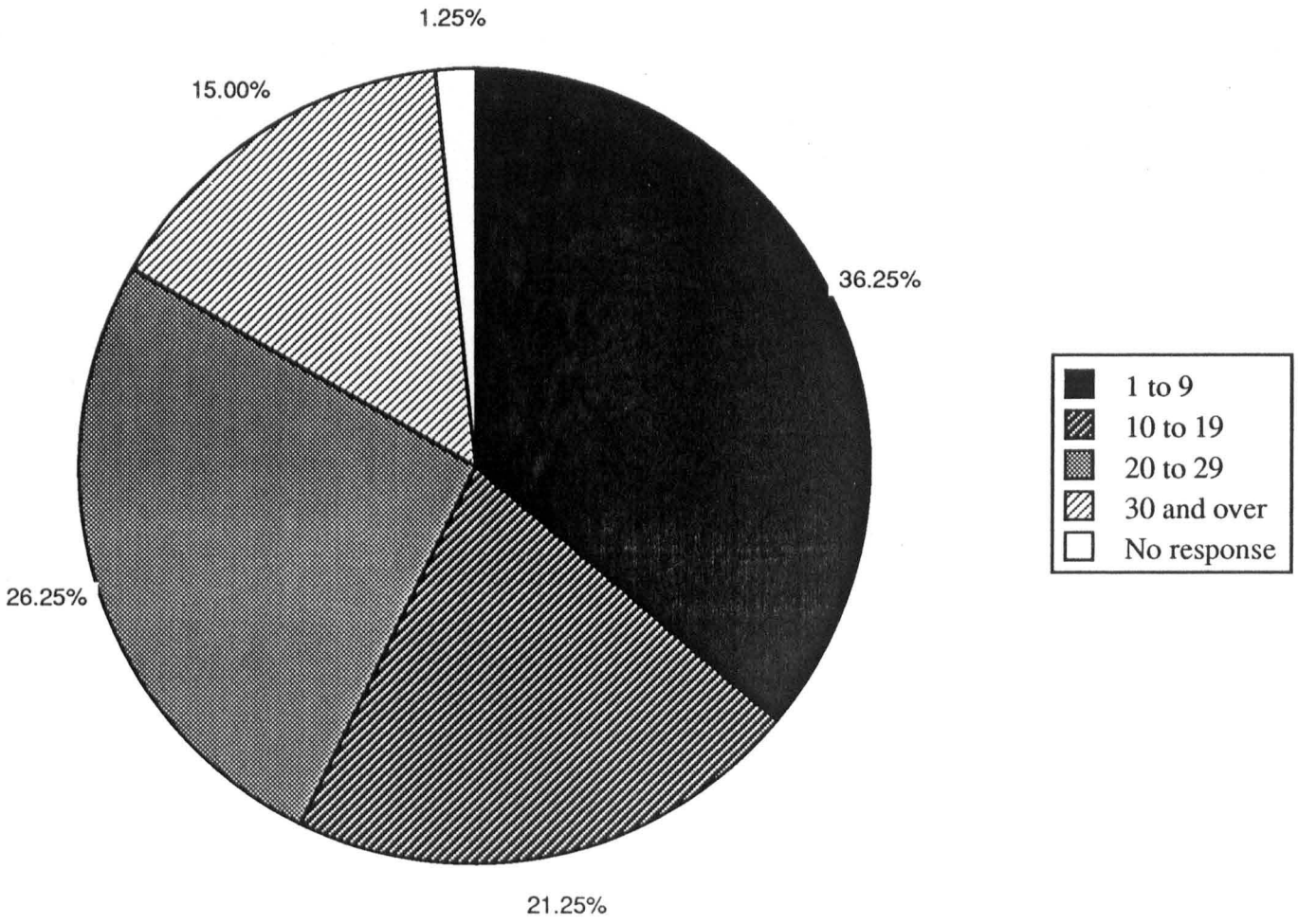

Figure 3. Distribution of respondents by number of years employed by extension (n=80)

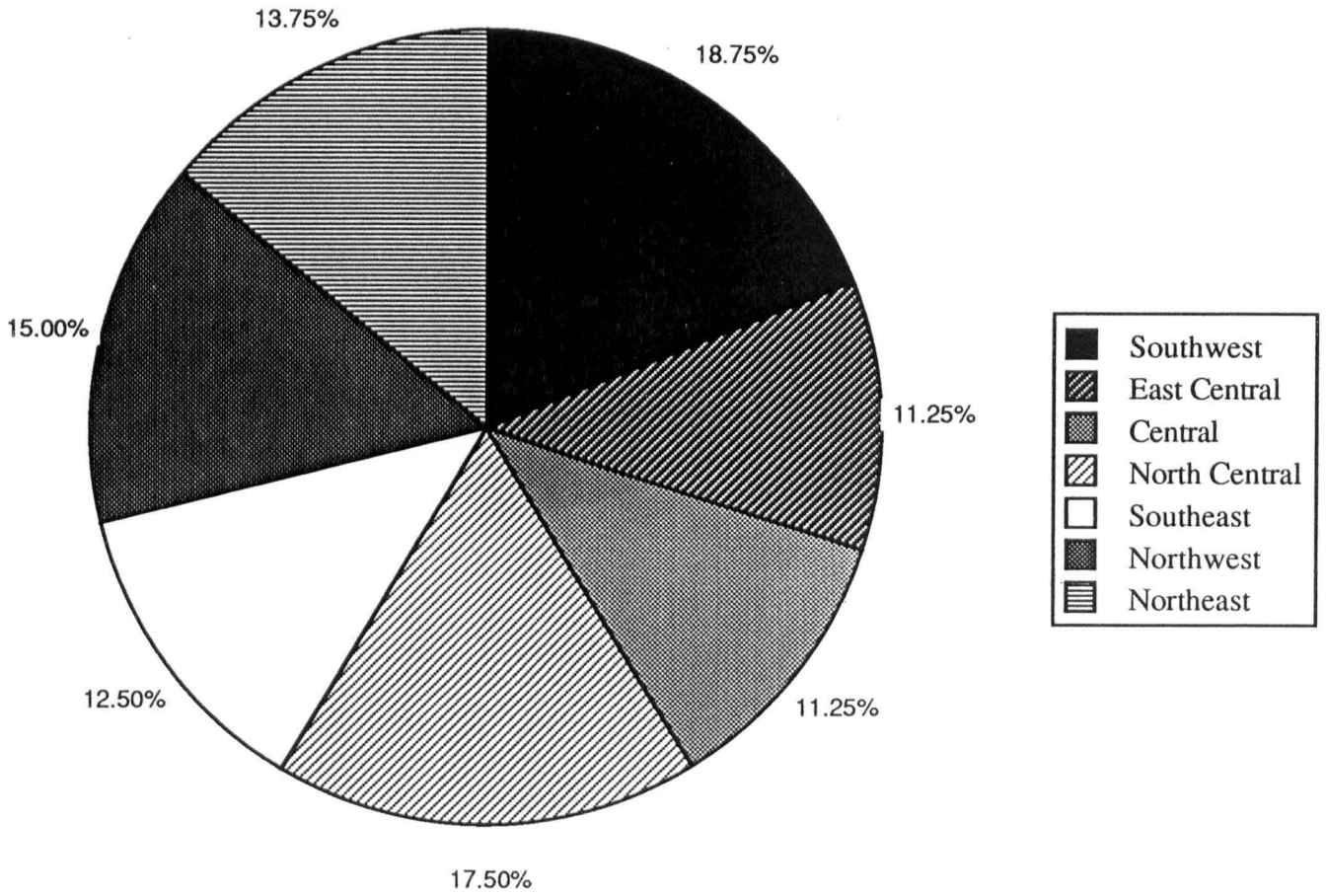

Figure 4. Distribution of respondents by extension administrative area (n=80)

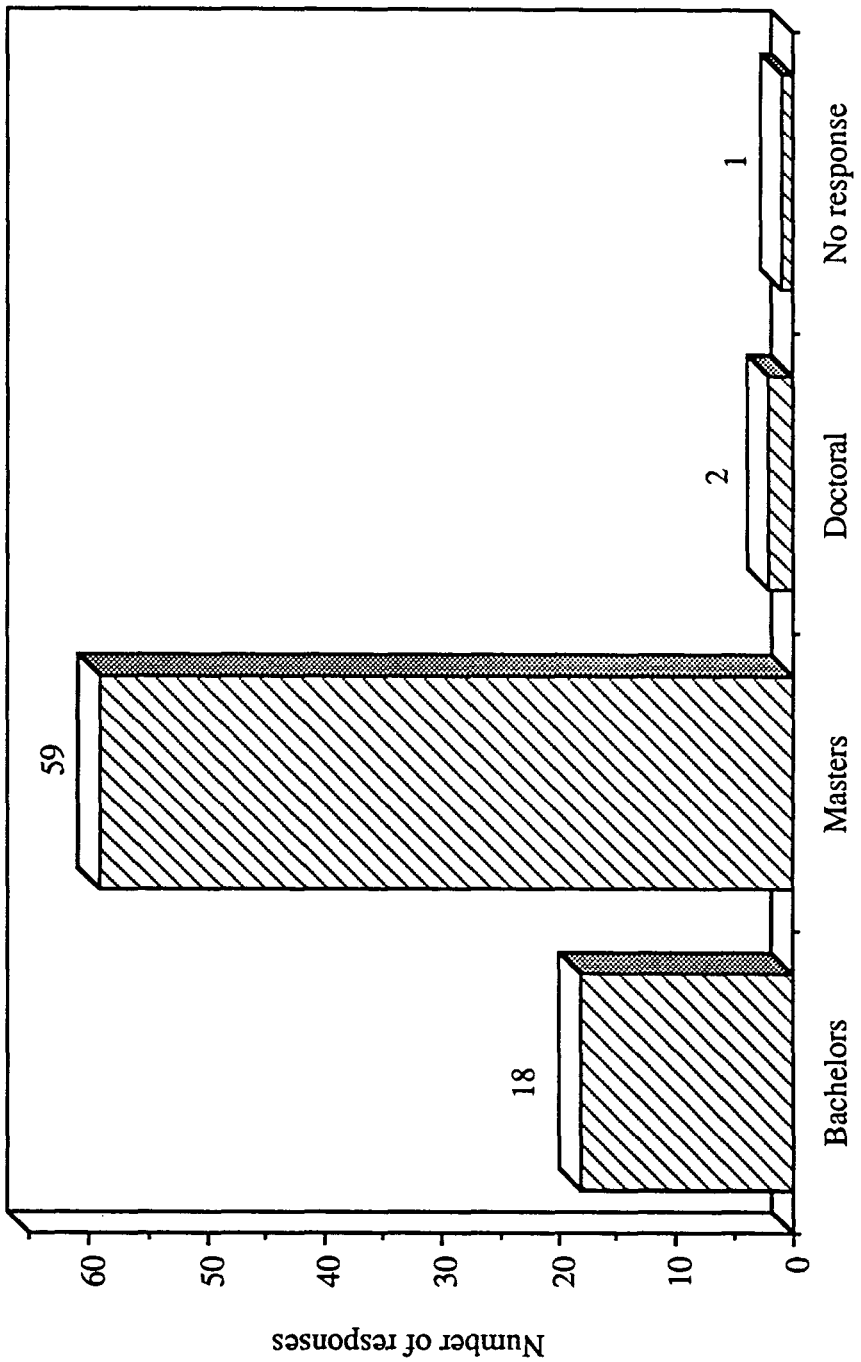

Figure 5. Distribution of respondents grouped by highest level of education attained (n = 80)

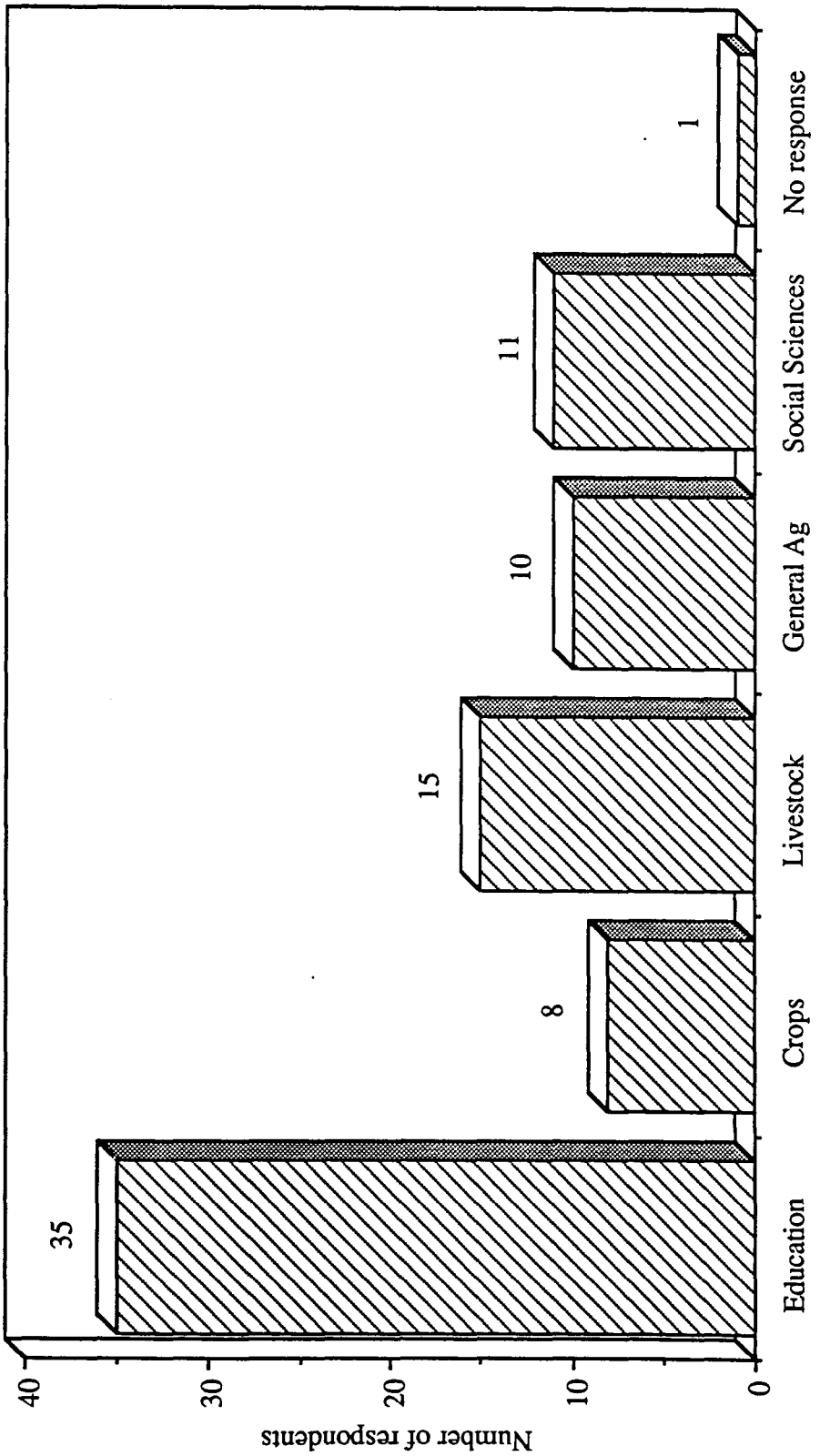

Figure 6. Distribution of respondents by major area of study for highest level of education (n = 80)

education, education, business education, and adult education); 8 (10%) of the respondents indicated a major in crop production (agronomy and plant pathology); 15 (18.8%) of the respondents indicated a major in livestock production (animal science, animal breeding, animal nutrition, poultry production, dairy science, and animal husbandry); 10 (12.5%) of the respondents reported a major in general agriculture (farm operations, masters of professional agriculture, agricultural engineering, and general agriculture); and 11 (13.7%) of the respondents indicated a major in social science (agricultural economics, agricultural business, farm management, and public administration). One (1.2%) respondent chose not to disclose their major area of study.

The distribution of the respondents' extension duties, in addition to agriculture, is presented in Figure 7. Five (6.3%) of the respondents indicated being only responsible for agricultural extension; 26 (32.5) of the respondents indicated having one additional extension responsibility; 38 (47.5%) of the respondents reported having responsibility for two additional extension program areas; and 10 (12.5%) respondents indicated being responsible for three additional extension duties. One (1.2%) respondent chose not to disclose the number of additional extension responsibilities.

The distribution of respondents by their having attended sustainable agriculture workshops or conferences is presented in Figure 8. Fifty-nine (73.7%) of the respondents indicated that they had attended sustainable agriculture workshops or conferences. Sixteen (20%) of the respondents reported that they had not attended sustainable agriculture workshops or conferences. Five respondents chose not to answer this item on the questionnaire.

Perceptions of Respondents Regarding the Importance of Sustainable Agriculture Items

This section describes the perceived importance of 43 topical items associated with sustainable agriculture on the part of the respondents. The respondents were asked to choose

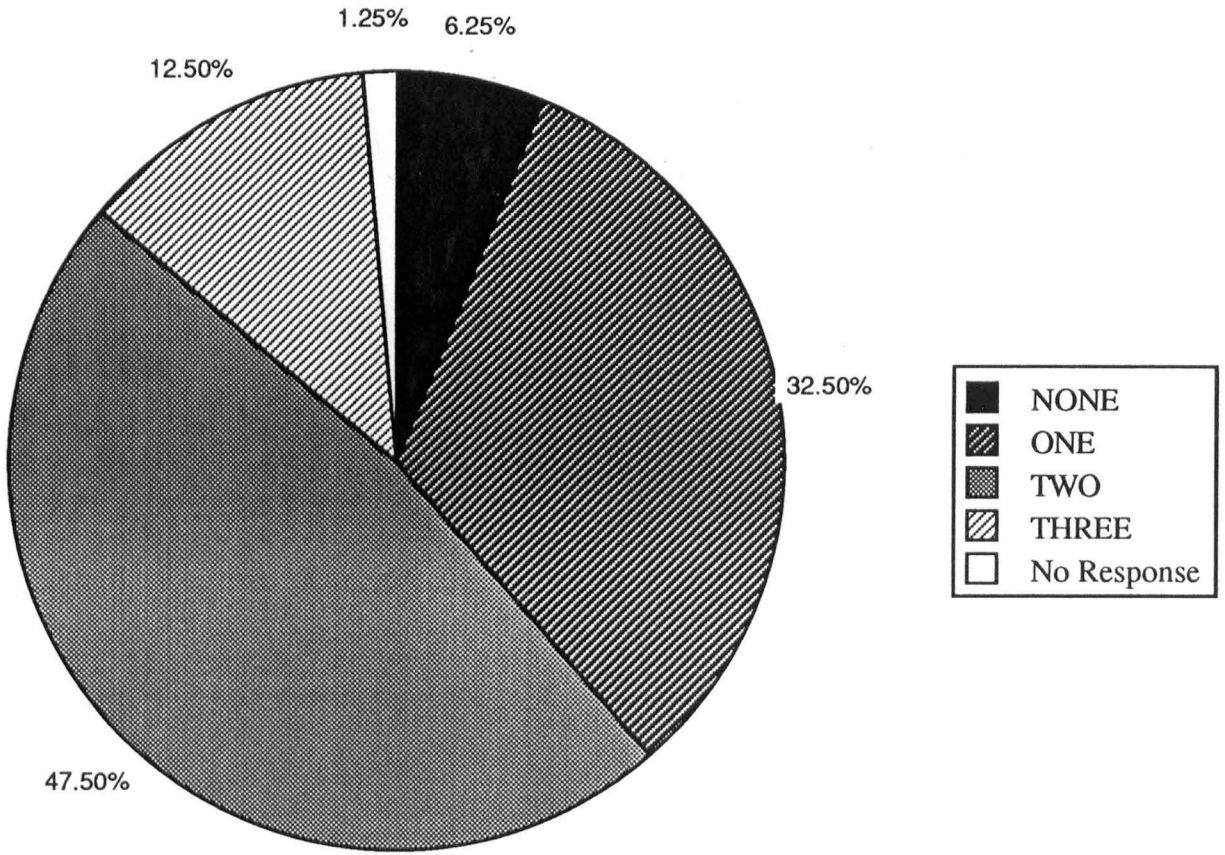

Figure 7. Distribution of respondents by the number of extension responsibilities in addition to agriculture (n = 80)

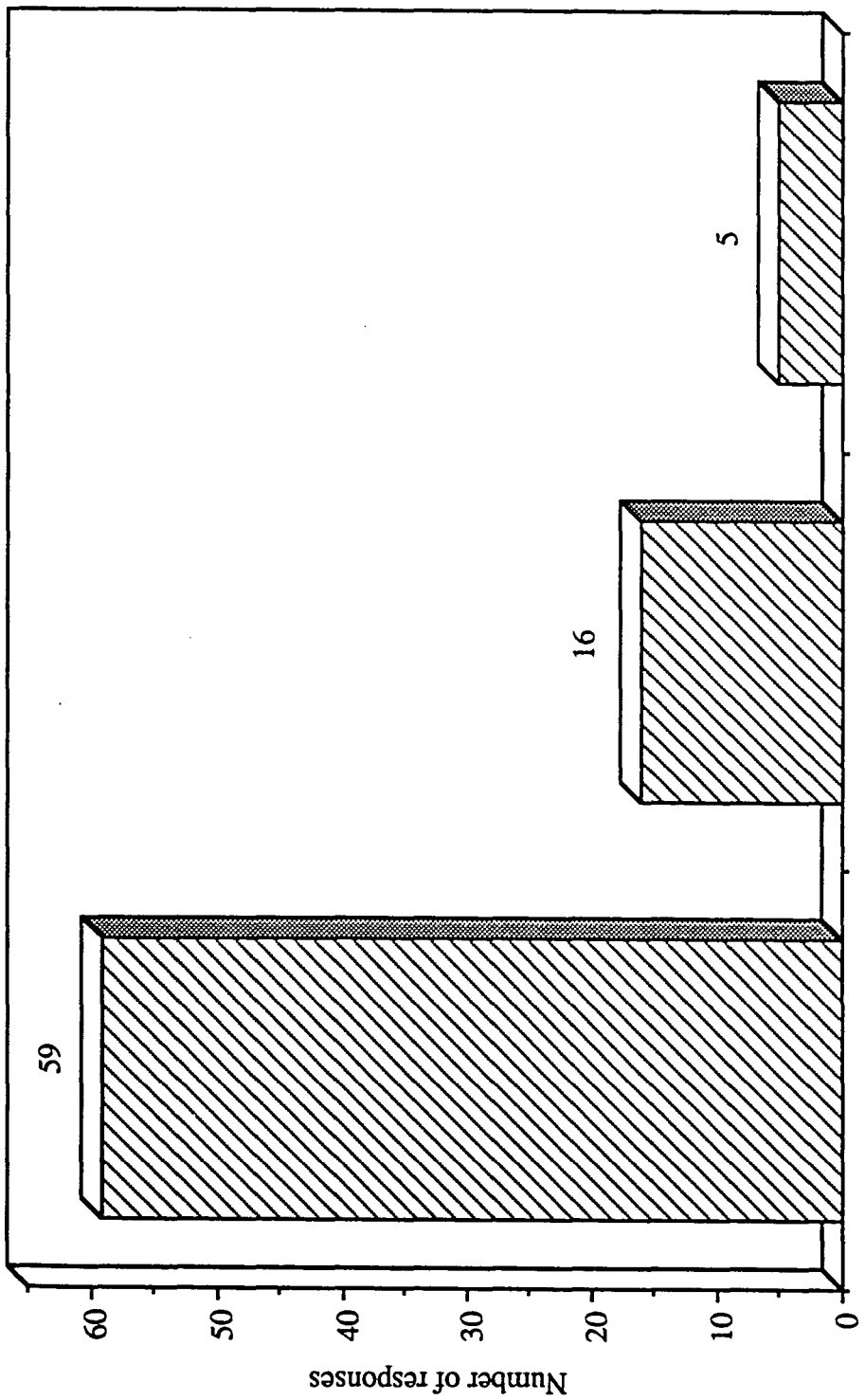

Figure 8. Distribution of respondents by their having attended sustainable agriculture workshops or conferences (n = 80)

the score which best reflected their personal perception of the importance of the items. The items were scored on a five-point Likert-type scale where 1 indicated "none"; 2 indicated "very little"; 3 indicated "some"; 4 indicated "moderate"; and 5 indicated "high". Table 2 shows the means and standard deviations ranked in descending order regarding the perceived level of importance of the topical items by the respondents.

There were fifteen items with mean scores above 4.00 (moderate) or higher. There were 3 items that were below a mean of 2.99 (very little) or lower on the rating scale. The highest mean rating was on the item "soil testing." This item also had the lowest variability with a standard deviation of 0.60. The second highest rated item was "nutrient management." This item also had a low variability with a standard deviation of 0.62. The third highest rated item was "residue management." The fourth highest rated item was "integrated pest management." The fifth rated item was "erosion control." The next 10 items were rated between means of 4.03 and 4.40. The next 28 items were rated below 4.00 The lowest rated item was "sinkhole treatment." The second lowest rated item was "Agroforestry." The next lowest rated item was "on-farm composting." The fourth lowest rated item was "wetland development for wildlife habitat." The fifth lowest rated item was "field windbreaks." The item with the highest variability was "contour stripcropping." This item had a standard deviation of 1.01. Overall, the respondents indicated that soil, water, nutrient, and pest management were very important items affecting the sustainability of agriculture in Iowa.

Table 3 presents significant statistical differences based upon the respondents' perceived importance of selected topical items in sustainable agriculture to their work when grouped by age. The item "alternative crops" indicated significant differences existing between group 2 (40 to 49 years of age) and group 1 (30 to 39 years of age) and between group 2 and group 3 (50 to 59 years of age). Group 2 rated "alternative crops" significantly higher than

Table 2. Means and standard deviations ranked in descending order regarding the perceived level of importance of topical items in sustainable agriculture.

Rank	Item	n	Mean[a]	S.D.
1	Soil testing	80	4.58	0.60
2	Nutrient management	80	4.54	0.62
3	Residue management	80	4.53	0.66
4	Integrated pest management	80	4.48	0.68
5	Erosion control	80	4.48	0.69
6	Manure management	80	4.40	0.69
7	Proper use and storage of agricultural chemicals	80	4.39	0.67
8	No-tillage	80	4.34	0.78
9	Groundwater contamination	80	4.26	0.73
10	Crop rotations	80	4.24	0.82
11	Surfacewater contamination	80	4.16	0.75
12	Economic analysis of sustainable agricultural systems	80	4.14	0.85
13	Plugging abandoned wells	80	4.13	0.79
14	Mulch tillage	80	4.04	0.86
15	Grassed waterways	80	4.03	0.90
16	On-farm research	79	3.91	0.92
17	Filter strips	80	3.88	0.91
18	Pasture management	80	3.86	0.98
19	Contouring	80	3.86	1.00
20	Ridge tillage	80	3.85	1.00
21	Manure testing	80	3.80	0.85
22	Planting trees and shrubs	80	3.76	0.86
23	Field borders	79	3.75	0.95
24	Contour stripcropping	80	3.71	1.01
25	Intensive short-duration grazing	80	3.66	0.98
26	Farmstead and feedlot windbreaks	80	3.65	0.78
27	Energy conservation	80	3.65	0.83
28	Contour buffer strips	80	3.64	0.98
29	Cover crops	80	3.58	0.97
30	Warm season grasses	80	3.45	0.94
31	Alternative crops	79	3.44	0.86
32	Social issues in sustainable agriculture	80	3.44	0.90
33	Tissue testing	80	3.41	0.92
34	Farmstead assessment for wellhead protection	79	3.34	0.93
35	Narrow stripcropping	80	3.25	0.92

[a]Scale: 1 = None; 2 = Very Little; 3 = Some; 4 = Moderate; 5 = High.

Table 2. Continued

Rank	Item	n	Mean	S.D.
36	Intercropping	80	3.14	0.81
37	Alternative livestock	80	3.10	0.89
38	Wetland development for water quality	79	3.09	0.92
39	Field windbreaks	80	2.99	0.86
40	Wetland development for wildlife habitat	80	2.91	0.97
41	On-farm composting	80	2.86	0.92
42	Agroforestry	79	2.39	0.91
43	Sinkhole treatment	80	2.29	0.91

Table 3. Significant means, standard deviations and F-values regarding the respondents' perceived importance to their work of selected items in sustainable agriculture when grouped by age.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob.
Alternative crops	22 3.00 0.62	20 4.10 0.64	27 3.37 0.88	7 3.57 0.98	7.54***[b]	0.0002
Alternative livestock	23 2.70 0.70	20 3.70 0.92	27 3.04 0.90	7 3.14 0.69	5.29**[c]	0.0024
Economic analysis of sustainable agriculture systems	23 3.78 1.00	20 4.65 0.59	27 4.15 0.77	7 3.86 0.90	4.35**[d]	0.0071
On-farm research	23 4.09 0.90	20 4.35 0.75	26 3.42 0.90	7 4.14 0.90	4.97**[e]	0.0034
Energy conservation	23 3.26 0.81	20 4.05 0.83	27 3.67 0.73	7 3.71 0.95	3.49*[f]	0.0198

[a]Group 1 = 30 to 39; Group 2 = 40 to 49; Group 3 = 50 to 59; and Group 4 = 60 and over.
[b]Significant differences exist between Groups 1 and 2 and between Groups 2 and 3.
[c]Significant differences exist between Groups 1 and 2.
[d]Significant differences exist between Groups 2 and 3.
[e]Significant differneces exist between Groups 2 and 3.
[f]Significant differneces exist between Groups 1 and 2.
***Indicates significance at 0.001
**Indicates significance at 0.01
*Indicates significance at 0.05

either group 1 or group 3. The item "alternative livestock" showed significant differences to exist between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age). Group 2 rated this item significantly higher than did group 1. The item "economic analysis of sustainable agricultural systems" indicated a significant difference between group 2 (40 to 49 years of age) and group 3 (50 to 59 years of age). Group 3 rated this item significantly lower than did group 2. The item "on-farm research" indicated significant differences between group 2 (40 to 49 years of age) and group 3 (50 to 59 years of age). Group 2 rated this item significantly higher than did group 3. The item "energy conservation" revealed significant differences between group 2 (40 to 49 years of age) and group 1 (30 to 39 years of age). Group 2 rated this item significantly higher than did group 1.

Table 4 indicates significant statistical differences based upon the respondents' number of years of employment with extension and the importance of selected items in sustainable agriculture to their work. Group 4 (30 or more years of employment) rated the item "planting trees and shrubs" significantly higher than did group 2 (10 to 19 years of employment). The item "on-farm research" was rated significantly higher by group 1 (1 to 9 years of employment) than by group 3 (20 to 29 years of employment). The item "intercropping" indicated significant differences existing between group 1 (1 to 9 years of employment) and group 2 (10 to 19 years of employment) and between group 2 and group 3 (20 to 29 years of employment). Group 2 rated this item significantly lower than either group 1 or group 3.

Table 5 presents significant statistical differences based upon the respondents' perceived importance of selected topical items in sustainable agriculture to their work when grouped by their highest level of education attained. Group 1 (Bachelor's Degree) rated the item "alternative livestock" significantly higher than group 2 (Master's Degree). The item "on-farm research" indicated significant differences existing between group 1 (Bachelor's Degree) and

Table 4. Significant means, standard deviations and F-values regarding the respondents' perceived importance to their work of selected items in sustainable agriculture when grouped by the number of years employed by extension.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob
Planting trees and shrubs	29 3.86 1.03	17 3.29 0.69	21 3.62 0.67	12 4.42 0.51	4.91**[b]	0.0036
On-farm research	29 4.24 0.79	17 4.00 1.00	21 3.48 0.75	11 3.73 1.19	3.21*[c]	0.0278
Intercropping	29 3.28 0.75	17 2.59 0.71	21 3.33 0.80	12 3.17 0.83	3.67*[d]	0.0159

[a]Group 1 = 1 to 9; Group 2 = 10 to 19; Group 3 = 20 to 29; and Group 4 = 30 and over.

[b]Significant differences exist between Groups 2 and 4.

[c]Significant differences exist between Groups 1 and 3.

[d]Significant differences exist between Groups 1 and 2 and between Groups 2 and 3.

**Indicates significance at 0.01.

*Indicates significance at 0.05.

Table 5. Significant means, standard deviations and F-values regarding the respondents' perceived importance to their work of selected items in sustainable agriculture when grouped by highest level of education attained.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3[a] n Mean S.D.	F-ratio	F-prob.
Alternative livestock	18 3.56 0.70	59 2.95 0.90	2 3.00 1.41	3.37*[b]	0.0394
On-farm research	18 4.00 0.84	58 3.93 0.90	2 2.00 0.00	4.84*[c]	0.0105

[a]Group 1 = Bachelors Degree; Group 2 = Masters Degree; and Group 3 = Doctoral Degree.
[b]Significant differences exist between Groups 1 and 2.
[c]Significant differences exist between Groups 1 and 3 and between Groups 2 and 3.
*Indicates significance at 0.05

group 3 (Doctoral Degree) and between group 3 and group 2 (Master's Degree). Group 3 rated this item significantly lower than either group 1 or group 2.

Table 6 shows significant statistical differences based upon the respondents' perceived importance of selected topical items in sustainable agriculture to their work when grouped by the major area of study for their highest level of education attained. The item "field borders" indicated a significant difference between group 1 (Education) and group 2 (Crop production). Group 2 rated "field borders" significantly higher than did group 1.

Table 7 presents significant statistical differences based upon the respondents' perceived importance of selected topical items in sustainable agriculture to their work when grouped by the extension administrative area in which they work. The item "agroforestry" indicated significant differences existing between group 5 (Southeast) and group 6 (Northwest), between group 6 and group 7 (Northeast), and between group 4 (North Central) and group 7. Group 7 rated "agroforestry" significantly higher than either group 4 or group 6.

Table 6. Significant means, standard deviations and F-values regarding the respondents' perceived importance to their work of selected items in sustainable agriculture when grouped by the major area of study for their highest level of education attained.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4 n Mean S.D.	Group 5[a] n Mean S.D.	F-ratio	F-prob.
Field borders	35 3.51 0.62	8 4.63 0.64	15 3.67 0.88	10 4.30 0.98	10 3.40 0.97	3.88**[b]	0.0065

[a]Group 1 = Education; Group 2 = Crop Production; Group 3 = Livestock Production; Group 4 = General Agriculture; and Group 5 = Social Science.

[b]Significant differences exist between Groups 1 and 2.

**Indicates significance at 0.01

"Agroforestry" was also rated significantly higher by group 5 than by group 6. Group 1 (Southwest) rated the item "On-farm research" significantly higher than group 2 (East Central). The item "sinkhole treatment" indicated significant differences to exist between group 2 (East Central) and group 6 (Northwest), between group 2 and group 1 (Southwest), between group 6 and group 7 (Northeast), between group 1 and group 7, and between group 5 (Southeast) and group 7. Group 2 rated "sinkhole treatment" significantly higher than either group 1 and group 6. Group 7 rated the same item significantly higher than group 1, group 5, and group 6. The item "pasture management" indicated significant differences existing between group 4 (North Central) and group 1 (Southwest), between group 4 and group 2 (East Central), between group 4 and group 3 (Central), between group 4 and group 5 (Southeast), and between group 4 and group 7 (Northeast). Group 4 rated "pasture management" significantly lower than did group 1, group 2, group 3, group 5, and group 7. The item "intensive short-duration grazing" indicated significant differences existing between group 4 (North Central) and group 1 (Southwest) and between group 4 and group 5 (Southeast). Group 4 rated

Table 7. Significant means, standard deviations, and F-values of the perceived importance to their work of selected items in sustainable agriculture when respondents are grouped by the administrative area in which they work.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4 n Mean S.D.	Group 5 n Mean S.D.	Group 6 n Mean S.D.	Group 7[a] n Mean S.D.	F-ratio	F-prob.
Agroforestry	14 2.07 0.73	9 2.33 0.50	9 2.89 0.78	14 1.93 0.62	10 3.00 0.94	12 1.75 0.62	11 3.18 1.08	6.25***[b]	0.0001
On-farm research	15 3.27 0.88	8 4.63 0.52	9 3.78 0.83	14 4.14 0.95	10 4.50 0.53	12 3.67 0.98	11 3.82 0.87	3.66**[c]	0.0032
Sinkhole treatment	15 1.47 0.64	9 3.11 1.45	9 2.33 1.22	14 2.64 1.22	10 1.80 1.03	12 1.42 0.51	11 3.64 1.12	7.63***[d]	0.0001
Pasture management	15 4.33 0.72	9 4.11 0.60	9 4.00 0.87	14 2.71 0.91	10 4.60 0.52	12 3.67 1.07	11 3.91 0.70	7.35***[e]	0.0001
Rotational grazing	15 4.07 0.46	9 3.89 0.60	9 3.56 1.24	14 2.79 1.05	10 4.50 0.53	12 3.50 1.00	11 3.55 0.93	4.73***[f]	0.0004
Warm season grasses	15 3.47 0.64	9 3.44 1.01	9 3.44 1.01	14 2.57 0.94	10 4.30 0.67	12 3.58 0.79	11 3.64 0.81	4.43***[g]	0.0007

[a]Group 1 = Southwest; Group 2 = East Central; Group 3 = Central; Group 4 = North Central; Group 5 = Southeast; Group 6 = Northwest; Group 7 = Northeast.

[b]Significant differences exist between Groups 4 and 7, between Groups 5 and 6, and between Groups 5 and 7.

[c]Significant differences exist between Groups 1 and 2.

[d]Significant differences exist between Groups 1 and 2, between Groups 1 and 7, between Groups 2 and 6, between Groups 5 and 7, and between Groups 6 and 7.

[e]Significant differences exist between Groups 1 and 4, bnetween Groups 2 and 4, between Groups 3 and 4, between Groups 4 and 5, and between Groups 4 and 7.

[f]Significant differences exist between Groups 1 and 4; and, 1 and 5.

[g]Significant differences exist between Groups 4 and 5.

**Significant at the 0.01 level.

***Significant at the 0.001 level.

"intensive short-duration grazing" significantly lower than either group 1 or group 5. Group 5 rated "warm season grasses" significantly higher than group 4.

Perceptions Regarding Present Level of Knowledge

This section describes the perceived present level of knowledge of 43 topical items associated with sustainable agriculture on the part of the respondents. The respondents were asked to choose the score which best reflected their present level of knowledge of the items. The items were scored on a five-point Likert-type scale where 1 indicated "none"; 2 indicated "very little"; 3 indicated "some"; 4 indicated "moderate"; and 5 indicated "high". Table 8 shows the means and standard deviations ranked in descending order regarding the perceived present level of knowledge of the topical items by the respondents.

There were 12 items with mean scores above 4.00 (moderate) or higher. There were six items that were below a mean of 2.99 (very little) or lower on the rating scale. The highest mean rating was on the item "soil testing." This item also had the lowest variability with a standard deviation of 0.63. The second highest rated item was "proper use and storage of agricultural chemicals." This item also had low variability with a standard deviation of 0.66. The third highest rated item was "integrated pest management." The next rated item was "plugging abandoned wells." The fifth highest rated item was "Crop rotations." The next 7 items were rated between means of 4.03 and 4.25. The next 31 items were rated below a mean of 4.00. The lowest rated item was "agroforestry." The second lowest rated item was "wetland development for wildlife habitat." The next lowest rated item was "wetland development for water quality." The fourth lowest rated item was "alternative livestock." The fifth lowest rated item was "sinkhole treatment." The item with the highest variability was "farmstead assessment for wellhead protection." This item had a standard deviation of 1.16.

Table 8. Means and standard deviations ranked in descending order regarding the respondents present level of knowledge of topical items in sustainable agriculture

Rank	Item	n	Mean[a]	S.D.
1	Soil testing	80	4.56	0.63
2	Proper use and storage of agricultural chemicals	80	4.46	0.66
3	Integrated pest management	80	4.41	0.69
4	Plugging abandoned wells	80	4.28	0.68
5	Crop rotations	80	4.26	0.73
6	Nutrient management	80	4.25	0.70
7	Groundwater contamination	80	4.14	0.61
8	Planting trees and shrubs	80	4.14	0.79
9	Manure management	80	4.11	0.80
10	Residue management	80	4.10	0.70
11	Erosion control	80	4.05	0.78
12	Surfacewater contamination	80	4.03	0.64
13	No-tillage	80	3.95	0.71
14	Grassed waterways	80	3.93	0.79
15	Contouring	80	3.93	0.87
16	Pasture management	80	3.80	0.89
17	Contour stripcropping	80	3.76	0.85
18	Farmstead and feedlot windbreaks	80	3.78	0.87
19	Filter strips	80	3.71	0.89
20	Mulch tillage	80	3.66	0.86
21	Field borders	79	3.65	0.89
22	Ridge tillage	80	3.59	0.87
23	Cover crops	80	3.58	0.91
24	Manure testing	79	3.56	0.83
25	Contour buffer strips	80	3.54	0.90
26	On-farm research	80	3.49	0.86
27	Warm season grasses	80	3.48	0.91
28	Energy conservation	80	3.43	0.84
29	Field windbreaks	80	3.43	0.95
30	Intensive short-duration grazing	80	3.41	0.88
31	Economic analysis of sustainable agricultural system	79	3.25	0.84
32	Alternative crops	79	3.22	0.73
33	Social issues in sustainable agriculture	79	3.18	0.84
34	Tissue testing	79	3.09	0.91
35	Farmstead assessment for wellhead protection	78	3.09	1.16

[a]Scale: 1 = None; 2 = Very Little; 3 = Some; 4 = Moderate; 5 = High.

Table 8. Continued

Rank	Item	n	Mean	S.D.
36	Narrow stripcropping	80	3.06	0.92
37	Intercropping	80	3.00	0.89
38	On-farm composting	80	2.98	1.04
39	Sinkhole treatment	80	2.83	1.13
40	Alternative livestock	80	2.80	0.82
41	Wetland development for water quality	80	2.74	0.96
42	Wetland development for wildlife habitat	80	2.69	0.92
43	Agroforestry	79	2.05	0.99

Overall, the respondents were very knowledgeable regarding soil, chemical, and pest management.

Table 9 presents significant statistical differences based upon the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by age. The item "alternative crops" indicated significant differences existing between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age) and between group 1 and group 4 (60 years of age and older). Group 1 rated "alternative crops" significantly lower than either group 2 or group 4. The item "alternative livestock" located significant differences existing between group 3 (50 to 59 years of age) and group 4 (60 years of age and older) and between group 4 and group 1 (30 to 39 years of age). Group 4 rated "alternative livestock" significantly higher than both group 1 and group 3.

Table 9. Significant means, standard deviations and F-values regarding the respondents' perceived present level of knowledge of selected items in sustainable agriculture when grouped by age.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob.
Alternative crops	22 2.86 0.77	20 3.50 0.51	27 3.11 0.75	7 3.71 0.49	4.53**[b]	0.0058
Alternative livestock	23 2.57 0.90	20 3.15 0.49	27 2.56 0.80	7 3.57 0.79	5.43**[c]	0.0020

[a]Group 1 = 30 to 39; Group 2 = 40 to 49; Group 3 = 50 to 59; and Group 4 = 60 and over.
[b]Significant differences exist between Groups 1 and 2; and, Groups 1 and 4.
[c]Significant differences exist between Groups 1 and 4; and, Groups 3 and 4.
**Indicates significance at 0.01

Table 10 shows significant statistical differences based upon the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by the number of years employed by extension. The item "planting trees and shrubs" indicated significant differences existing between group 1 (1 to 9 years of employment) and group 4 (30 or more years of employment). Group 4 rated this item significantly higher than did group 1. A significant difference was found between group 2 (10 to 19 years of employment) and group 3 (20 to 29 years of employment) regarding the item "contouring." Group 3 rated this item significantly higher than did group 2.

Table 11 presents significant statistical differences based upon the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by their highest level of education attained. The item "tissue testing" showed a significant difference between group 1 (Bachelor's Degree) and group 3 (Doctoral Degree). Group 3 rated this item significantly higher than did group 1.

Table 12 indicates significant statistical differences between the respondents' major area of study for their highest level of education attained and their perceived present level of knowledge of selected topical items in sustainable agriculture. The item "alternative crops" found significant differences existing between group 5 (Social Science) and group 1 (Education), between group 5 and group 2 (Crop Production), and between group 5 and group 3 (Livestock Production). Group 5 rated "Alternative crops" significantly lower than group 1, group 2, and group 3. The item "on-farm composting" indicated significant differences between group 5 (Social Science) and group 1 (Education) and between group 5 and group 3 (Livestock Production). Group 5 rated this item lower than either group 1 or group 3.

Table 13 presents significant statistical differences based upon the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by the extension administrative area in which they work. The item "sinkhole treatment" indicated

Table 10. Significant means, standard deviations and F-values regarding the respondents' perceived present level of knowledge in selected items in sustainable agriculture when grouped by the number of years employed by the Extension Service.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob
Planting trees and shrubs	29 3.79 0.90	17 4.24 0.75	21 4.19 0.60	12 4.75 0.45	4.94**[b]	0.0035
Contouring	29 4.00 0.89	17 3.47 0.80	21 4.33 0.73	12 3.75 0.87	3.68*[c]	0.0157

[a]Group 1 = 1 to 9; Group 2 = 10 to 19; Group 3 = 20 to 29; and Group 4 = 30 and over.

[b]Significant differences exist between Groups 1 and 4.

[c]Significant differences exist between Groups 2 and 3.

**Indicates significance at 0.01.

*Indicates significance at 0.05.

Table 11. Significant means, standard deviations and F-values regarding the respondents' perceived present level of knowledge in selected items in sustainable agriculture when grouped by the highest level of education attained.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	F-ratio	F-prob.
Tissue testing	18 2.67 0.97	59 3.14 0.80	2 4.50 0.71	5.11**[b]	0.0083

[a]Group 1 = Bachelors Degree; Group 2 = Masters Degree; and Group 3 = Doctoral Degree.
[b]Significant differences exist between Groups 1 and 3.
**Indicates significance at 0.01

Table 12. Significant means, standard deviations and F-values regarding the respondents' perceived present level of knowledge of selected items in sustainable agriculture when grouped by the major area of study for their highest level of education attained.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4 n Mean S.D.	Group 5[a] n Mean S.D.	F-ratio	F-prob.
Alternative crops	34 3.32 0.59	8 3.50 0.53	15 3.33 0.49	10 3.20 1.03	11 2.45 0.82	4.20**[b]	0.0041
On-farm composting	35 3.29 1.02	8 2.88 1.13	15 3.13 0.74	10 2.90 1.10	11 1.82 0.60	5.19***[c]	0.0010

[a]Group 1 = Education; Group 2 = Crop Production; Group 3 = Livestock Production; Group 4 = General Agriculture; and Group 5 = Social Science.
[b]Significant differences exist between Groups 5 and 1, between Groups 5 and 2, and between Groups 5 and 3.
[c]Significant differences exist between Groups 5 and 1 and between Groups 5 and 3.
***Indicates significance at 0.001
**Indicates significance at 0.01

Table 13. Significant means, standard deviations and F-values regarding the respondents' perceived present level of knowledge in selected items in sustainable agriculture when grouped by the Extension administrative area in which they work.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4 n Mean S.D.	Group 5 n Mean S.D.	Group 6 n Mean S.D.	Group 7[a] n Mean S.D.	F-ratio	F-prob.
Sinkhole treatment	15 2.13 0.83	9 3.89 1.05	9 3.00 1.41	14 3.00 1.04	10 2.40 0.84	12 2.25 0.97	11 3.55 0.82	4.99***[b]	0.0002
Pasture Management	15 4.40 0.74	9 3.89 0.93	9 3.67 0.87	14 3.21 0.89	10 4.10 0.99	12 3.50 0.67	11 3.82 0.75	3.00*[c]	0.0113

[a]Group 1 = Southwest; Group 2 = East Central; Group 3 = Central; Group 4 = North Central; Group 5 = Southeast; Group 6 = Northwest; Group 7 = Northeast.

[b]Significant differences exist between Groups 1 and 2 and between Groups 2 and 6.

[c]Significant differences exist between Groups 1 and 4, between Groups 2 and 4, between Groups 4 and 5, and between Groups 4 and 7.

*Significant at the 0.05 level.

***Significant at the 0.001 level.

significant differences between group 2 (East Central) and group 6 (Northwest) and between group 2 and group 1 (Southwest). Group 2 rated this item significantly higher than either group 1 or group 6. A significant difference was also indicated regarding the item "pasture management" between group 1 (Southwest) and group 4 (North Central). Group 1 rated this item significantly higher than did group 4.

Table 14 indicates significant statistical differences between the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by their number of extension responsibilities in addition to agriculture. The item "proper use and storage of agricultural chemicals" indicated a significant difference between group 1 (No additional extension responsibilities) and group 4 (Three additional extension responsibilities). Group 4 rated this item higher than did group 1. The item "tissue testing" yielded a significant difference between group 2 (One additional extension responsibility) and group 4 (Three additional extension responsibilities) and between group 3 (two additional extension responsibilities) and group 4. Group 4 rated this item significantly higher than either group 2 or group 3.

Table 15 presents means, standard deviations, and t-values of the perceived present level of knowledge regarding selected topical items in sustainable agriculture to the work of the respondents when grouped by their having previously attended conferences or workshops in sustainable agriculture. The item "on-farm research" indicated a significant difference existing between those who had and those who had not attended sustainable agriculture workshops or conferences. Those who had attended workshops or conferences rated their knowledge of "on-farm research" significantly higher than those who had not attended workshops or conferences. The item "energy conservation" found a significant difference existing between the two groups of respondents. Those who had attended workshops or conferences rated their present level of knowledge regarding "energy conservation" significantly higher than those

Table 14. Significant means, standard deviations and F-values regarding the respondents' perceived present level of knowledge in selected items in sustainable agriculture when grouped by the number of extension responsibilities held in addition to agriculture.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D	F-ratio	F-prob.
Proper use and storage of agricultural chemicals	5 3.80 1.10	26 4.54 0.58	38 4.37 0.63	10 4.90 0.32	3.96*[b]	0.0112
Tissue testing	5 3.00 1.00	26 3.04 0.87	37 2.86 0.79	10 4.00 0.94	4.75**[c]	0.0044

[a]Group 1 = None (only agriculture); Group 2 = One; Group 3 = Two; and Group 4 = Three.

[b]Significant differences exist between Groups 1 and 4.

[c]Significant differences exist between Groups 2 and 4 and between Groups 3 and 4.

*Indicates significance at 0.05

**Indiactes significance at 0.01

Table 15. Significant means, standard deviations, and t-values of the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by their having previously attended conferences or workshops in sustainable agriculture.

	Yes		No		
Item	n	Mean S.D.	n	Mean[a] S.D.	t-value
On-farm research	58	3.59 0.89	16	3.06 0.68	2.21*
Energy conservation	59	3.54 0.88	16	3.00 0.63	2.31*
Grassed waterways	59	3.97 0.85	16	3.63 0.50	2.04*

[a]1 = None; 2 = Very Little; 3 = Some; 4 = Moderate; and 5 = High

*$p \leq 0.05$

who had not attended workshops or conferences. A significant difference was also found to exist between the two groups of respondents regarding the item "grassed waterways." Those who had attended workshops or conferences rated their present level of knowledge of "grassed waterways" significantly higher than those who had not previously attended workshops or conferences.

Perceptions Regarding the Need for Additional Training

This section describes the perceived need for additional training in 43 topical items associated with sustainable agriculture on the part of the respondents. The respondents were asked to indicate their level of agreement with the topical items. The items were scored on a five-point Likert-type scale where 1 indicated "strongly disagree"; 2 indicated "disagree"; 3 indicated "neutral"; 4 indicated "agree"; and 5 indicated "strongly agree". Table 16 shows the means and standard deviations ranked in descending order regarding the perceived need for additional training of the topical items by the respondents.

There were 3 items with mean scores above 4.00 (agree) or higher. There were six items which were below a mean of 2.99 (disagree) or lower on the rating scale. The highest mean rating was on the item "economic analysis of sustainable agriculture systems." The second highest rated item was "no tillage." This item also had the lowest variability with a standard deviation of 0.79. The next highest rated item was "residue management." The fourth highest rated item was "manure management." This item also had a low variability with a standard deviation of 0.84. The next 32 items were rated between means of 3.15 and 3.87. The next six items were rated below 3.00. The lowest rated item was "sinkhole treatment." This item also had the highest variability with a standard deviation of 1.08. The second lowest rated item was "agroforestry." The next lowest rated item was "planting trees and shrubs." The fourth lowest rated item was "on-farm composting." The fifth lowest rated item was "field

Table 16. Means and standard deviations ranked in descending order regarding the respondents need for addtional training in each of the selected topical items in sustainable agriculture

Rank	Item	n	Mean[a]	S.D.
1	Economic analysis of sustainable agricultural systems	80	4.28	0.86
2	No-tillage	79	4.04	0.79
3	Residue management	79	4.00	0.86
4	Integrated pest management	79	3.92	0.87
5	Manure management	80	3.89	0.84
6	Ridge tillage	79	3.87	0.85
7	Pasture management	78	3.87	0.86
8	Intensive short-duration grazing	78	3.83	0.99
9	Nutrient management	79	3.81	0.94
10	Alternative crops	80	3.80	0.82
11	Mulch tillage	80	3.75	0.90
12	Alternative livestock	80	3.71	0.85
13	On-farm research	80	3.69	0.87
14	Social issues in sustainable agriculture	80	3.66	0.95
15	Erosion control	80	3.65	0.90
16	Warm season grasses	78	3.59	0.92
17	Crop rotations	79	3.47	0.93
18	Manure testing	80	3.45	0.86
19	Groundwater contamination	80	3.43	0.87
19	Energy conservation	79	3.43	0.87
21	Cover crops	80	3.43	0.95
22	Intercropping	80	3.41	0.90
23	Narrow stripcropping	80	3.39	0.88
24	Tissue testing	80	3.35	0.94
25	Soil testing	80	3.33	1.05
26	Filter strips	80	3.30	0.92
27	Wetland development for water quality	80	3.30	0.96
28	Surface water contamination	80	3.29	0.96
29	Grasseed waterways	80	3.28	0.93
30	Field borders	80	3.24	0.98
31	Proper use and storage of agricultural chemicals	79	3.22	1.02
32	Farmstead assessment for wellhead protection	80	3.21	1.00

[a]Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree.

Table 16. Continued

Rank	Item	n	Mean	S.D.
33	Contour buffer strips	80	3.20	0.96
34	Farmstead and feedlot windbreaks	80	3.19	0.97
35	Contour stripcropping	80	3.18	0.93
36	Contouring	80	3.15	0.94
37	Wetland development for wildlife habitat	80	3.15	1.05
38	Plugging abandoned wells	80	2.95	0.93
39	Field windbreaks	80	2.91	0.86
40	On-farm composting	80	2.91	0.93
41	Planting trees and shrubs	80	2.89	1.06
42	Agroforestry	79	2.66	1.04
43	Sinkhole treatment	80	2.53	1.08

windbreaks." Overall, the respondents indicated a strong need for additional training in economic analysis of sustainable agricultural systems as well as soil management.

Table 17 presents significant statistical differences based upon the age of the respondents and their perceived need for additional training in selected topical items in sustainable agriculture. The item "alternative crops" indicated significant differences between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age) and between group 1 and group 3 (50 to 59 years of age), and between group 1 and group 4 (60 years of age and older). Group 1 rated "alternative crops" significantly lower than did group 2, group 3 and group 4. The item "alternative livestock" indicated a significant difference between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age). Group 2 rated this item significantly higher than did group 1. The item "social issues in sustainable agriculture" found significant differences existing between group 1 (30 to 39 years of age) and group 3 (50 to 59 years of age) and between group 1 and group 4 (60 years of age and older). Group 1 rated this item significantly lower than either group 3 or group 4. The item "mulch tillage" found a significant difference to exist between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age). Group 2 rated "mulch tillage" significantly higher than did group 1. The item "ridge tillage" indicated a significant difference between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age). Group 2 rated this item significantly higher than did group 1.

Table 18 shows significant statistical differences between the number of years the respondents have been employed by extension and their perceived need for training in selected topical items associated with sustainable agriculture. The item "agroforestry" yielded a significant difference between group 2 (10 to 19 years of employment) and group 4 (30 or more years of employment). Group 4 rated this item significantly higher than did group 2. The item "planting trees and shrubs" indicated a significant difference to exist between group 1 (1 to 9 years of employment) and group 2 (10 to 19 years of employment). Group 2 rated

Table 17. Significant means, standard deviations and F-values regarding the respondents' perceived need for additional training in selected items in sustainable agriculture when grouped by age.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob.
Alternative crops	22 3.22 0.90	20 4.15 0.75	27 3.89 0.58	7 4.14 0.69	6.85***[b]	0.0004
Alternative livestock	23 3.22 0.85	20 4.05 0.94	27 3.81 0.68	7 3.86 0.69	4.24**[c]	0.0080
Social issues in sustainable agriculture	23 3.13 1.06	20 3.70 0.80	27 3.93 0.87	7 4.29 0.76	4.51**[d]	0.0059
Mulch tillage	23 3.35 1.15	20 4.15 0.81	27 3.81 0.56	6 3.50 1.05	3.21*[e]	0.0281
Ridge tillage	23 3.39 0.89	20 4.25 0.97	27 3.96 0.65	7 4.00 0.63	4.23**[f]	0.0082

[a]Group 1 = 30 to 39; Group 2 = 40 to 49; Group 3 = 50 to 59; and Group 4 = 60 and over.

[b]Significant differences exist between Groups 1 and 2, between Groups 1 and 3, and between Groups 1 and 4.

[c]Significant differences exist between Groups 1 and 2.

[d]Significant differences exist between Groups 1 and 3 and between Groups 1 and 4.

[e]Significant differneces exist between Groups 1 and 2.

[f]Significant differneces exist between Groups 1 and 2.

***Indicates significance at 0.001

**Indicates significance at 0.01

*Indicates significance at 0.05

Table 18. Significant means, standard deviations and F-values regarding the respondents' perceived need for additional training in selected items in sustainable agriculture when grouped by the number of years employed by extension.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob
Agroforestry	29 2.72 1.13	17 1.94 0.90	21 2.84 0.93	11 3.18 0.60	4.37**[b]	0.0069
Planting trees and shrubs	29 3.28 0.96	17 2.29 1.05	21 3.00 1.05	12 2.50 0.90	4.17**[c]	0.0087
Plugging abandoned wells	29 3.21 1.01	17 2.41 0.87	21 3.10 0.70	11 2.83 0.94	3.08*[d]	0.0323
Farmstead assessment for wellhead protection	29 3.48 0.91	17 2.59 1.06	21 3.33 0.91	12 3.25 1.06	3.23*[e]	0.0272
Tissue testing	29 3.55 0.99	17 2.71 1.10	21 3.48 0.75	12 3.58 0.51	3.79*[f]	0.0138

[a]Group 1 = 1 to 9; Group 2 = 10 to 19; Group 3 = 20 to 29; and Group 4 = 30 and over.
[b]Significant differences exist between Groups 2 and 4.
[c]Significant differences exist between Groups 1 and 2.
[d]Significant differences exist between Groups 1 and 2.
[e]Significant differences exist between Groups 1 and 2.
[f]Significant differences exist between Groups 1 and 2.
**Indicates significance at 0.01.
*Indicates significance at 0.05.

"planting trees and shrubs" significantly lower than group 1. The item "plugging abandoned wells" indicated a significant difference between group 1 (1 to 9 years of employment) and group 2 (10 to 19 years of employment). Group 1 rated this item significantly higher than did group 2. The item "farmstead assessment for wellhead protection" indicated, yet again, a significant difference between group 1 (1 to 9 years of employment) and group 2 (10 to 19 years of employment). Group 2 rated this item significantly higher than did group 1. The item "tissue testing" again yielded a difference between group 1 (1 to 9 years of employment) and group 2 (10 to 19 years of employment). Group 1 rated "tissue testing" significantly higher than did group 2.

Table 19 presents significant statistical differences between the respondents' perceived need for additional training in selected topical items in sustainable agriculture when grouped by their highest level of education attained. The item "on-farm research" indicated significant differences existing between group 1 (Bachelor's Degree) and group 2 (Master's Degree) and

Table 19. Significant means, standard deviations and F-values regarding the respondents' perceived need for additional training in selected items in sustainable agriculture when grouped by the highest level of education attained.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3[a] n Mean S.D.	F- ratio	F- prob.
On-farm research	18 3.83 0.86	59 3.71 0.81	2 2.00 1.41	4.41*[b]	0.0154

[a]Group 1 = Bachelors Degree; Group 2 = Masters Degree; and Group 3 = Doctoral Degree.
[b]Significant differences exist between Groups 1 and 2 and between Groups 1 and 3.
*Indicates significance at 0.05

between group 1 and group 3 (Doctoral Degree). Group 1 rated "on-farm research" significantly higher than either group 2 or group 3.

Table 20 shows significant statistical differences between the extension administration area in which the respondents' work and their perceived need for additional training in selected topical items in sustainable agriculture. The item "agroforestry" indicated a significant difference between group 6 (Northwest) and group 7 (Northeast). Group 7 rated this item significantly higher than did group 6. The item "pasture management" found significant differences between group 4 (North Central) and group 1 (Southwest), between group 4 and group 2 (East Central), between group 4 and group 5 (Southeast), and between group 4 and group 7 (Northeast). Group 4 rated "pasture management" significantly lower than did group 1, group 2, group 5, or group 7. The item "intensive short-duration grazing" indicated a significant difference between group 2 (East Central) and group 4 (North Central). Group 2 rated this item significantly higher than did group 4.

Table 21 presents means, standard deviations, and t-values of the respondents' perceived need for additional training regarding selected topical items in sustainable agriculture when grouped by their having previously attended conferences or workshops in sustainable agriculture. The item "alternative crops" indicated a significant difference to exist between the two groups of respondents. Those respondents who had not attended workshops or conferences rated their need for additional training regarding "alternative crops" significantly higher than those who had attended workshops or conferences. Data analysis indicated a significant difference existing between the two groups of respondents regarding the item "economic analysis of sustainable agricultural systems." Those who had not attended workshops or conferences rated their need for additional training in "economic analysis of sustainable agricultural systems" significantly higher than those who had attended workshops or conferences. A significant difference was also found between the two groups regarding the

Table 20. Significant means, standard deviations and F-values regarding the respondents' perceived need for additional training in selected items in sustainable agriculture when grouped by the administrative area in which they work.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4 n Mean S.D.	Group 5 n Mean S.D.	Group 6 n Mean S.D.	Group 7[a] n Mean S.D.	F-ratio	F-prob.
Agroforestry	14 2.43 0.76	9 2.56 1.13	9 3.33 1.00	14 2.21 0.80	10 2.90 0.74	12 2.00 1.04	11 3.55 1.04	4.31***[b]	0.0009
Pasture Management	15 4.07 0.80	9 4.33 0.71	8 3.88 0.64	14 3.00 0.78	10 4.20 0.63	11 3.73 0.90	11 4.18 0.75	4.45***[c]	0.0007
Rotational grazing	15 4.20 0.94	9 4.44 0.53	8 3.88 0.83	14 3.00 1.04	10 4.40 0.57	11 3.45 1.21	11 4.00 0.77	3.67**[d]	0.0031

[a]Group 1 = Southwest; Group 2 = East Central; Group 3 = Central; Group 4 = North Central; Group 5 = Southeast; Group 6 = Northwest; Group 7 = Northeast.

[b]Significant differences exist between Groups 6 and 7.

[c]Significant differences exist between Groups 1 and 4, between Groups 2 and 4, between Groups 4 and 5, and between Groups 4 and 7.

[d]Significant differences exist between Groups 2 and 4.

**Significant at the 0.01 level.

***Significant at the 0.001 level.

Table 21. Significant means, standard deviations, and t-values of the respondents perceived need for addtional training regarding selected topical items in sustainable agriculture when grouped by their having previously attended conferences or workshops in sustainable agriculture.

	Yes		No		
Item	n	Mean[a] S.D.	n	Mean[a] S.D.	t-value
Alternative crops	58	3.68 0.84	16	4.19 0.54	-2.29*
Economic analysis of sustainable agricultural systems	59	4.19 0.92	16	4.69 0.48	-2.96**
Energy conservation	58	3.28 0.81	16	3.75 0.93	-2.00*
Surface water contamination	59	3.10 0.92	16	3.81 0.91	-2.74*
Proper use and storage of agricultural chemicals	58	3.03 0.96	16	3.63 1.09	-2.13*
Manure management	59	3.71 0.81	16	4.31 0.79	-2.64**

[a]1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; and 5 = Strongly Agree

**$p \leq 0.01$

*$p \leq 0.05$

item "proper use and storage of agricultural chemicals." Those who had not attended workshops or conferences rated their need for additional training regarding the "proper use and storage of agricultural chemicals" significantly higher than those who had attended workshops or conferences. A final significant difference between the two groups was found to exist regarding the item "manure management." Those who had not attended workshops or conferences rated their need for additional training on "manure management" significantly higher than those who had attended workshops or conferences.

Perceptions of Respondents Regarding the Need for Informational Materials

This section describes the perceived need for informational materials in 43 topical items associated with sustainable agriculture on the part of the respondents. The respondents were asked to indicate their level of agreement with the topical items. The items were scored on a five-point Likert-type scale where 1 indicated "strongly disagree"; 2 indicated "disagree"; 3 indicated "neutral"; 4 indicated "agree"; and 5 indicated "strongly agree". Table 22 shows the means and standard deviations ranked in descending order regarding the perceived need for informational materials of the topical items by the respondents.

There were seven items with mean scores of 4.00 (agree) or higher. There were only two items below a mean of 2.99 (disagree) or lower on the rating scale. The highest mean rating was on the item "economic analysis of sustainable agricultural systems." The second highest rated item was "no tillage." This item also had the lowest variability with a standard deviation of 0.75. The next highest rated item was "residue management." The fourth highest rated item was "Manure management." The fifth highest rated item was "ridge tillage." The next two items received means of 4.01 and 4.00, respectively. The next 34 items were rated between means of 3.10 and 3.91. The last two items were rated below 3.00. The lowest rated item was "sinkhole treatment." This item also had the highest variability with a standard

Table 22. Means and standard deviations ranked in descending order regarding the respondents need for informational materials in each of the selected topical items in sustainable agriculture

Rank	Item	n	Mean	S.D.
1	Economic analysis of sustainable agricultural systems	80	4.39	0.76
2	No-tillage	80	4.19	0.75
3	Residue management	80	4.19	0.80
4	Livestock manure management	79	4.08	0.78
5	Ridge tillage	80	4.08	0.81
6	Pasture management	80	4.01	0.90
7	Intensive short-duration grazing	79	4.00	0.96
8	Integrated pest management	80	3.91	0.92
9	Mulch tillage	80	3.86	0.90
10	On-farm research	80	3.86	0.95
11	Alternative livestock	80	3.85	0.89
12	Nutrient management	80	3.85	0.93
13	Alternative crops	80	3.84	0.96
14	Erosion control	80	3.81	0.89
15	Animal manure testing	80	3.71	0.93
16	Crop rotations	78	3.68	0.93
17	Warm season grasses	79	3.68	1.01
18	Social issues in sustainable agriculture	80	3.65	0.98
19	Energy conservation	79	3.63	0.87
20	Groundwater contamination	80	3.59	0.92
21	Tissue testing	80	3.58	0.98
22	Cover crops	80	3.56	0.98
23	Surface water contamination	80	3.54	0.87
24	Soil testing	80	3.49	1.07
25	Filter strips	80	3.49	0.96
26	Field borders	80	3.48	0.94
27	Grassed waterways	80	3.43	0.93
28	Wetland development for water quality	79	3.42	1.02
29	Intercropping	80	3.41	0.90
30	Proper use and storage of agricultural chemicals	79	3.41	1.13
31	Farmstead assessment for wellhead protection	80	3.40	0.96
32	Contour stripcropping	80	3.39	0.89

[a]Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree.

Table 22. Continued

Rank	Item	n	Mean	S.D.
33	Narrow stripcropping	80	3.36	0.90
34	Contour buffer strips	80	3.36	0.92
35	Farmstead and feedlot windbreaks	80	3.34	0.87
36	Contouring	80	3.34	0.93
37	Wetland development for wildlife habitat	79	3.30	1.07
38	On-farm research	80	3.21	0.98
39	Planting trees and shrubs	80	3.18	0.99
40	Plugging abandoned wells	80	3.16	1.07
41	Field windbreaks	80	3.10	0.91
42	Agroforestry	79	2.89	1.09
43	Sinkhole treatment	80	2.61	1.22

deviation of 1.22. The second lowest rated item was "agroforestry." The next lowest rated item was "Field windbreaks." The fourth lowest rated item was "plugging abandoned wells." The fifth lowest item was "planting trees and shrubs." In general, the respondents indicated that their greatest need for information lies in materials that deal with economic analysis of sustainable agricultural systems. The respondents also indicated a need for materials that cover tillage practices; and manure, residue, and pasture management.

Table 23 presents significant statistical differences between the respondents' perceived need for informational material in selected topical items in sustainable agriculture when grouped by age. The item "alternative crops" indicated a significant difference between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age). Group 2 rated "alternative crops" significantly higher than did group 1. The item "alternative livestock" indicated significant differences between group 1 (30 to 39 years of age) and group 2 (40 to 49 years of age) and between group 1 and group 3 (50 to 59 years of age). Group 1 rated this item significantly lower than either group 2 or group 3. The item "integrated pest management" indicated a significant difference between group 2 (40 to 49 years of age) and group 4 (60 years of age and older). Group 2 rated this item significantly higher than did group 4. The item "no tillage" yielded a significant difference between group 2 (40 to 49 years of age) and group 3 (50 to 59 years of age). Group 2 rated this item significantly higher than did group 3.

Table 24 shows significant statistical differences between the highest level of education attained by the respondents and their perceived need for informational material in selected topical items in sustainable agriculture. The item "on-farm research" indicated significant differences existing between group 1 (Bachelor's Degree) and group 3 (Doctoral Degree) and between group 2 (Master's Degree) and group 3. Group 3 rated "on-farm research" significantly lower than either group 1 or group 2.

Table 23. Significant means, standard deviations and F-values regarding the respondents' perceived need for informational material in selected items in sustainable agriculture when grouped by age.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob.
Alternative crops	23 3.30 0.97	20 4.25 0.64	27 3.93 0.92	7 3.71 1.25	4.13**[b]	0.0092
Alternative livestock	23 3.26 0.92	20 4.20 0.70	27 3.96 0.90	7 4.14 0.38	5.58**[c]	0.0017
Integrated pest management	23 3.78 1.00	20 4.40 0.75	27 3.74 0.76	7 3.29 1.11	3.79*[d]	0.0138
No tillage	23 4.17 0.83	20 4.45 0.60	27 3.89 0.70	6 4.33 0.82	3.24*[e]	0.0269

[a]Group 1 = 30 to 39; Group 2 = 40 to 49; Group 3 = 50 to 59; and Group 4 = 60 and over.
[b]Significant differences exist between Groups 1 and 2.
[c]Significant differences exist between Groups 1 and 2 and between Groups 1 and 3.
[d]Significant differences exist between Groups 2 and 4.
[e]Significant differneces exist between Groups 2 and 3.
**Indicates significance at 0.01.
*Indicates significance at 0.05.

Table 24. Significant means, standard deviations and F-values regarding the respondents' perceived need for informational material in selected items in sustainable agriculture when grouped by the highest level of education attained.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3[a] n Mean S.D.	F-ratio	F-prob.
On-farm research	18 3.94 1.00	59 3.92 0.88	2 2.00 1.41	4.32*[b]	0.0168

[a]Group 1 = Bachelors Degree; Group 2 = Masters Degree; and Group 3 = Doctoral Degree.
[b]Significant differences exist between Groups 1 and 3 and between Groups 2 and 3.
*Indicates significance at 0.05.

Table 25 presents significant statistical differences between the extension administrative area in which the respondents work and their perceived need for informational materials in selected topical items in sustainable agriculture. The item "agroforestry" indicated significant differences existing between group 6 (Northwest) and group 5 (Southeast) and between group 6 and group 7 (Northeast). Group 6 rate "agroforestry" significantly lower than either group 5 or group 7. The item "alternative crops" found a significant difference between group 6 (Northwest) and group 3 (Central). Group 3 rated this item significantly higher than did group 6. The item "pasture management" yielded significant differences between group 4 (North Central) and group 1 (Southwest) and between group 4 and group 2 (East Central). Group 4 rated "pasture management" significantly lower than either group 1 or group 2. The item "intensive short-duration grazing" indicated a significant difference between group 4 (North Central) and group 1 (Southwest). Group 1 rated this item significantly lower than did group 4.

Table 26 shows significant statistical differences between the number of extension responsibilities, in addition to agriculture, held by the respondents and their perceived need for informational materials in selected items in sustainable agriculture. The item "no tillage" yielded a significant difference between group 3 (Two additional extension responsibilities) and group 4 (Three additional extension responsibilities). Group 3 rated "no tillage" significantly higher than did group 4.

Overall Priority Rankings of Training and Informational Material Needs

In determining the overall priority rankings of training and informational material needs of the respondents in selected topical items in sustainable agriculture, the researcher first attempted to utilize the modified Borich needs assessment model as suggested by Waters and Haskell (1989). After analyzing the results of the modified Borich needs assessment approach,

Table 25. Significant means, standard deviations and F-values regarding the respondents' perceived need for informational material in selected items in sustainable agriculture when grouped by the extension administrative area in which they work.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4 n Mean S.D.	Group 5 n Mean S.D.	Group 6 n Mean S.D.	Group 7[a] n Mean S.D.	F-ratio	F-prob.
Agroforestry	14 2.43 0.85	9 3.00 1.12	9 3.33 0.71	14 2.43 0.76	10 3.70 0.67	12 2.08 1.16	11 3.73 1.10	5.79***[b]	0.0001
Alternative crops	15 3.67 0.72	9 3.78 0.83	9 4.67 0.50	14 3.50 0.65	10 4.20 0.63	12 3.33 1.15	11 4.18 0.98	3.50**[c]	0.0042
Pasture Management	15 4.40 0.74	9 4.44 0.73	9 4.13 0.64	14 3.07 0.92	10 4.20 0.63	12 4.00 0.95	11 4.09 0.83	4.38***[d]	0.0008
Rotational grazing	15 4.40 0.74	9 4.33 0.71	8 4.13 0.64	14 3.14 1.10	10 4.40 0.70	12 3.83 1.11	11 4.00 0.89	3.36**[e]	0.0056

[a]Group 1 = Southwest; Group 2 = East Central; Group 3 = Central; Group 4 = North Central; Group 5 = Southeast; Group 6 = Northwest; Group 7 = Northeast.

[b]Significant differences exist between Groups 5 and 6 and between Groups 6 and 7.

[c]Significant differences exist between Groups 3 and 6.

[d]Significant differences exist between Groups 1 and 4 and between Groups 2 and 4.

[e]Significant differences exist between Groups 1 and 4.

***Significant at the 0.001 level.

**Significant at the 0.01 level.

Table 26. Significant means, standard deviations and F-values regarding the respondents' perceived need for informational material in selected items in sustainable agriculture when grouped by the number of Extension responsibilities held in addition to agriculture.

Item	Group 1 n Mean S.D.	Group 2 n Mean S.D.	Group 3 n Mean S.D.	Group 4[a] n Mean S.D.	F-ratio	F-prob.
Alternative crops	5 4.20 0.45	25 4.08 0.70	38 4.42 0.72	10 3.60 0.84	3.74*[b]	0.0146

[a]Group 1 = None (only agriculture); Group 2 = One; Group 3 = Two; and Group 4 = Three.

[b]Significant differences exist between Groups 3 and 4.

*Indicates significance at 0.05

the researcher determined that this particular model failed to take into account the differences which existed among the scores of importance to work, present level of knowledge, and the two needs scores, additional training needs and informational material needs, regarding the selected topical items in sustainable agriculture.

The researcher developed a new model utilizing the four sets of scores which takes into account the differences. The present level of knowledge score was subtracted from the importance to work score. This number was then multiplied by the importance to work score. The resulting product was then added to the need for additional training score. The sum was then divided by two to produce the final score used for prioritizing the perceived needs of the respondents for the development of educational programs in selected topical items in sustainable agriculture. Prioritizing the need for informational materials was accomplished by merely substituting the need for additional training score with the need for additional

informational materials score. The following equation produced the scores for ranking each of the selected topical items in sustainable agriculture:

$$\frac{[(ITW - PLK) \times ITW] + NAT}{2}$$

$$\frac{[(ITW - PLK) \times ITW] + INFO}{2}$$

ITW = Importance to work score

PLK = Present level of knowledge score

NAT = Need for additional training score

INFO = Need for informational materials score

Since the scores were rated on a 5 point Likert-type scale (1 being low and 5 being high), the scores for selected topical items in sustainable agriculture could theoretically range from +12.5 to -1.5. Interpreting the calculated scores shown in Table 27 and Table 28 is suggested as follows:

1. An item which has a negative score would not be considered appropriate for use in developing educational programs or informational material since it resulted from a combination of either a low importance to work score, a high present level of knowledge score, or a low need for additional training score or need for informational materials score.
2. An item with a score relatively close to zero would also be considered inappropriate since it would seem that the existing present level of knowledge, need for additional training, or need for informational materials is very similar to the respondents' perceived importance of the item.

3. Items having positive scores should be rank ordered and educational programs and informational materials in sustainable agriculture developed around those having the highest values.

Table 27 presents the training need priorities in sustainable agriculture perceived by county-level agricultural extension professionals in Iowa as determined by a selected statistical formula. The highest ranking priority training need was the item "economic anlaysis of sustainable agricultural systems." The second highest training need was "residue management." The third highest ranking training need was in "no tillage." The next highest training need was "on-farm research." And, the fifth highest training need in sustainable agriculture was "erosion control." The lowest ranked training need was "planting trees and shrubs." The next lowest ranked training item was "field windbreaks." The third lowest training need was "sinkhole treatment." The next lowest ranked training need was "plugging abandoned wells." And the fifth lowest perceived training need was "farmstead and feedlot windbreaks."

Table 28 presents the priority needs in informational materials regarding sustainable agriculture perceived by county-level agricultural extension professionals in Iowa as determined by a selected statistical formula. The highest ranking priority need for informational materials was "economic analysis of sustainable agricultural systems." The second highest ranked informational materials need was in "residue management." The next highest ranked need for informational materials was "no-tillage" systems. The fourth highest ranked informational materials need was regarding "on-farm research." And the fifth highest rated priority need for informational materials was "erosion control." The lowest ranked priority need for informational materials was "sinkhole treatment." The second lowest priority need was "field windbreaks." The next lowest ranked priority need for informational materials was "planting trees and shrubs." The fourth lowest informational materials priority need was

Table 27. Priority training needs in sustainable agriculture listed in decending order as determined by a selected needs assessment formula

Priority	Item	Score
1	Economic analysis of sustainable agriculture systems	4.32
2	Residue management	3.18
3	No-tillage	3.10
4	On-farm research	3.04
5	Erosion control	2.92
6	Mulch tillage	2.82
7	Manure management	2.76
8	Ridge tillage	2.73
9	Intensive short-duration grazing	2.67
10	Nutrient management	2.65
11	Social issues in sustainable agriculture	2.59
12	Alternative crops	2.57
13	Tissue testing	2.55
14	Alternative livestock	2.54
15	Wetland development for water quality	2.46
16	Manure testing	2.45
17	Energy conservation	2.35
18	Pasture management	2.31
19	Narrow stripcropping	2.29
20	Integrated pest management	2.27
21	Wetland development for wildlife habitat	2.23
22	Farmstead assessment for wellhead protection	2.21
23	Groundwater contamination	2.16
23	Filter strips	2.16
25	Surface water contamination	2.14
26	Intercropping	2.12
27	Contour buffer strips	2.10
28	Grassed waterways	2.08
28	Field borders	2.08
30	Warm season grasses	2.03
31	Cover crops	1.98
32	Crop rotations	1.88
33	Contour stripcropping	1.81
34	Soil testing	1.77
34	Contouring	1.77
36	On-farm composting	1.61
37	Proper use and storage of agricultural chemicals	1.59
38	Farmstead and feedlot windbreaks	1.48
39	Agroforestry	1.42
40	Plugging abandoned wells	1.33
41	Sinkhole treatment	1.01
42	Field windbreaks	0.99
43	Planting trees and shrubs	0.98

Table 28. Priority informational material needs in sustainable agriculture listed in decending order as determined by a selected needs assessment formula

Priority	Item	Score
1	Economic analysis of sustainable agriculture systems	4.38
2	Residue management	3.27
3	No-tillage	3.18
4	On-farm research	3.13
5	Erosion control	3.00
6	Manure management	2.87
6	Mulch tillage	2.87
8	Ridge tillage	2.84
9	Intensive short-duration grazing	2.73
10	Tissue testing	2.67
11	Nutrient management	2.66
12	Alternative livestock	2.61
13	Alternative crops	2.59
14	Social issues in sustainable agriculture	2.58
14	Manure testing	2.58
16	Wetland development for water quality	2.50
17	Energy conservation	2.46
18	Pasture management	2.38
19	Wetland development for wildlife habitat	2.29
19	Farmstead assessment for wellhead protection	2.29
21	Surface water contamination	2.27
21	Narrow stripcropping	2.27
23	Integrated pest management	2.26
23	Filter strips	2.26
25	Groundwater contamination	2.24
26	Field borders	2.20
27	Contour buffer strips	2.18
28	Grassed waterways	2.16
29	Intercropping	2.12
30	Warm season grasses	2.08
31	Cover crops	2.05
32	Crop rotations	1.99
33	Contour stripcropping	1.91
34	Contouring	1.87
35	Soil testing	1.86
36	On-farm composting	1.76
37	Proper use and storage of agricultural chemicals	1.68
38	Farmstead and feedlot windbreaks	1.56
39	Agroforestry	1.54
40	Plugging abandoned wells	1.44
41	Planting trees and shrubs	1.12
42	Field windbreaks	1.09
43	Sinkhole treatment	1.05

"plugging abandoned wells." And the fifth lowest ranked priority need for informational materials in sustainable agriculture was "farmstead and feedlot windbreaks."

Correlation coefficients were calculated among the four sets of scores in an effort to determine relationships among them. According to Waters and Haskell (1989), "if the correlation between any two of the scores is high, the logic of using both scores as criteria for determining need would not be supported" (p. 30). As shown in Table 29, correlations among the four scores were at best moderate (Hinkle , Wiersma, and Jurs, 1988). The maximum explained variance associated with any two of the scores was 45 percent ($r = 0.52$) between "importance to work" and "need for informational materials."

To further validate the results of this study, the relationships among the four sets of scores were explored further to determine if the addition of the importance to work scores and present level of knowledge scores is contributing anything to the needs assessment model above and beyond the information gained by asking the respondent to rate each of the selected topical items in sustainable agriculture based solely on their perceived needs for additional training and informational materials. A regression equation ($1 - R^2$) was utilized to analyze the variance of each of the scores and determine whether each of the scores was independently

Table 29. Pearson correlations among scores on importance to work, present level of knowledge, need for additional training, and need for informational materials.

	Present level of knowledge	Need for additional training	Need for informational materials
Importance to work	0.34	0.49	0.52
Present level of knowledge		-0.02	0.09

providing additional information to the needs assessment model. If most of the variance in the two needs scores, additional training needs and informational material needs, could be explained by the combined variance of the importance to work scores and present level of knowledge scores, there would be no logic in using these additional scores to determine additional training and informational material needs of the respondents in sustainable agriculture since additional training needs scores and informational material scores would be adequately represent the other two scores (Waters and Haskell, 1989). Seventy-six percent of the variance in the importance to work scores is unexplained when the present level of knowledge scores and need for additional training scores are regressed upon the importance to work scores. Also, 96% of the variance in the present level of knowledge scores remains unexplained when importance to work scores and need for additional training scores are regressed upon present level of knowledge scores. Ninety-six percent of the variance in need for additional training scores is unexplained when importance to work scores and present level of knowledge scores are regressed upon need for additional training scores. With regards to need for informational material scores, 76% of the variance in the importance to work scores is unexplained when present level of knowledge scores and need for informational material scores are regressed upon importance to work scores. Ninety-nine percent of the variance in the present level of knowledge scores remains unexplained when importance to work scores and need for informational material scores are regressed upon the present level of knowledge scores. Finally, 99% of the variance in the need for informational material scores is left unexplained when the importance to work scores and present level of knowledge scores are regressed upon the need for informational material scores. These results give evidence that a single score, or a combination of two scores, is not an adequate replacement of the other score or scores. Therefore, each of the scores are individually contributing information to the needs assessment model.

Comments Made by Respondents.

Comments were invited from the participants to give useful insight concerning the perceptions of county-level agricultural extension professionals in Iowa toward the topic of sustainable agriculture and the role of Iowa State University Extension providing leadership in this area. This section allowed for the respondents to be candid and discuss items not included on the questionnaire. Comments contained in this section were used from both completed and uncompleted questionnaires which were returned. The comments have been somewhat edited for grammar, but the main points of the respondents have been preserved.

I think we have to look at the long-term when dealing with sustainable agriculture. It is an important issue.

I believe that educational programs conducted by Extension have supported a sustainable agriculture. We cannot control the application of technology.

The county staff need more materials on this subject matter. Please give us information in program form.

Sustainable agriculture will vary greatly by counties and within each county.

I don't think we need to dwell on this. You'd be amazed at the good information we county people can come up with. However, more quick references would be helpful to save us time answering questions.

Extension must coordinate and enhance improved cooperation between sustainable agriculture proponents and agribusiness.

I find it interesting you use the word leadership. I think we need to worry about providing leadership and less about "satisfying clientele".

I had a hard time answering some of your questions. I thought some of them were loaded.

Agricultural extension staff in the counties need to be provided with continuous, up-dated training.

This topic has become much more mainstream in the past few years. We are integrating sustainable agriculture in to our regular program of educational topics.

"Soil" items might be better addressed by the Soil Conservation Service. Extension needs to provide sustainable techniques as alternative to farmers.

This study certainly points up the need for more intensive training for extension agriculturalists.

I get too many of these (surveys) to complete and don't complete a lot of them but thought this was a worthwhile survey. If Extension field staff are going to supply up-to-date, useful information to clientele we need adequate training. People sending these surveys out need to look at the time of year they are sent. They need to be sent during less busy time of the year and not around county fair and other busy times.

The definition of sustainable agriculture is quite different to different people.

Need continues to be high for providing leadership and information in sustainable agriculture.

I feel Iowa State University Extension is providing excellent leadership in this area. The agricultural extension administrators are doing a very good job.

Extension's role will be limited by its tunnel vision and its bureaucratic bias.

How do I take time to learn all the topics and do all of my other work.

I believe it should be made a primary program area but extension agriculturalists are stretched pretty thin and with "down-sizing", that will probably not change much.

We need more printed material to use with clientele. We need research-based information.

In the past we have had very little research-based data to use in this area. Hopefully, some will be available soon.

I don't have time for lots of training. I need resources to share with clientele.

I just want training on topics that will be implemented.

Some of these topics are handled on referrals to other agencies ie. SCS. We just need to know enough to make appropriate referrals in some cases.

Sustainable agriculture is a dead horse. No one works to be sustainable, you work to gain - make a profit. You can do nothing and the state will sustain you.

We must have economic (business) data on the viability of the concept.

Sustainable agriculture must be profitable. I feel that we need more help in understanding the economics of sustainable agriculture.

For many of these areas we already have excellent materials developed. I am aware of some of the Farmstead Assessment materials that were being developed. I'd like to know why these haven't been shared with us. Our state specialists need to do a much better job of sharing information.

> Any information and education that relates to the productivity and profitability of agriculture is sustainable in nature. Iowa State University Extension has always promoted the sustainability of agriculture. To suggest that sustainable agriculture is different from using proper farming practices is misleading. We are not creating a "now" sustainable agriculture. Rather, we are promoting sound farming practices. Our focus has not changed; however, the terminology has.
>
> Extension must take the lead in teaching farmers about the following issues: Protecting water quality; saving the soil; reducing production costs; record keeping; and overall farm management. There will be many places to get help concerning technical information but only Iowa State University Extension will help the producer sort it out, decide what is best for the individual situation.

An analysis of the comments made by respondents indicated that as a group they were supportive of sustainable agriculture. Several respondents indicated that Iowa State University Extension must continue to provide leadership in sustainable agriculture in Iowa. Several respondents also indicated the need for sustainable agriculture educational programs for agricultural extension professionals, farmers, and agribusinesses. Several county-level agricultural extension professionals indicated a need for more research-based informational materials to assist them in the field. Several comments were also directed towards the economics of sustainable agriculture. Many respondents commented that they would like to become more familiar with assessing the economic viability of sustainable farming systems.

CHAPTER V. DISCUSSION

The main purpose of this study was to identify and analyze the perceptions of county-level agricultural extension agents in Iowa regarding the need for additional training and informational needs in sustainable agriculture. A secondary purpose was to identify the implications of these perceptions to educational practice.

The specific objectives of this study were as follows:

1. To identify the level of importance to their work of selected topical items in sustainable agriculture as perceived by county-level agricultural extension professionals in Iowa.
2. To determine the present level of knowledge of county-level agricultural extension professionals regarding selected topical items in sustainable agriculture.
3. To identify training needs focused on sustainable agriculture of county-level agricultural extension professionals.
4. To identify the need for informational materials on selected topics in sustainable agriculture as perceived by county-level agricultural extension professionals.
5. To determine the self-perceived impact of an educational intervention related to topics in sustainable agriculture according to county-level agricultural extension professionals.
6. To compare the various groups of respondents regarding their perceptions of selected topical items in sustainable agriculture and demographic factors.

The findings of the study as they relate to the stated objectives are discussed in this chapter. The discussion also includes a focus on the implications for agricultural and extension education programs. The discussions are organized under the following sections: (1) Demographic characteristics of the respondents, (2) Perceived importance of selected topical

items in sustainable agriculture, (3) Present level of knowledge of respondents regarding sustainable agriculture, (4) Training needs of respondents in sustainable agriculture, (5) Need of respondents for informational materials in sustainable agriculture, and (6) Educational implications of the findings of the study.

Demographic Characteristics of the Respondents

The study found that the respondents were all male, highly educated, and well experienced in extension . The demographic information showed that most respondents (87.5%) were between the ages of 30 and 59 and had been employed by Iowa State University Extension between 10 and more than 30 years (62.5%). The results also indicated that the respondents were highly educated with most respondents (75%) having attained either a Master's or Doctoral Degree, a large number of respondents (43.8%) indicated the major area of study for their highest level of education was education. The distribution of responses from the seven extension administrative areas was fairly even, however, the largest number of responses (18.8%) came from the Southwest administrative area. The majority of respondents (92.5%) indicated that, in addition to agriculture, they had at least one additional extension responsibility. The majority of the respondents (73.7%) also indicated having attended at least one workshop or conference related to sustainable agriculture. These findings seem to indicate that the respondents constitute a significant educational resource from which those involved in agriculture in Iowa can draw.

Perceived Importance of Selected Topical Items in Sustainable Agriculture

One of the main objectives of this study was to identify the level of importance of selected topical items in sustainable agriculture as perceived by county-level agricultural extension professionals in Iowa. It was observed that fifteen of the topical items in sustainable

agriculture received a rating of four or above. The next twenty-three topical items were rated between 3.09 and 3.91. The remaining five topical items in sustainable agriculture were rated between 2.29 and 2.99. The item "soil testing" received the highest rating on the importance scale while "sinkhole treatment" received the lowest rating. The findings suggest that the majority of the selected topical items in sustainable agriculture were deemed to be important be the respondents. As a group, the respondents rated thirty-eight of the items three or above, a rating of "some" or above in importance. The relatively low ratings of topical items such as "agroforestry" and "on-farm composting" may have been due to a lack of knowledge of and/or exposure to these topical areas in sustainable agriculture.

A Scheffe test, used with a one-way analysis of variance procedure, located several significant statistical differences between the respondents' perceived importance of the selected topical items in sustainable agriculture when grouped by the different demographic characteristics. The characteristic "age" showed that those between the ages of 40 and 49 years rated five topical items significantly higher than did the other age groups based on importance. The characteristic "years of experience" gave evidence that those with 20 or more years of experience rated the importance of several items significantly higher than did those with other amounts of experience with Iowa State University Extension. Respondents with between 1 and 9 years of employment experience rated "on-farm research" significantly higher than did those with more substantial experience. This finding may be due to the recent emphasis regarding the concept of on-farm research in the state. The characteristic "level of education" found that those with a Bachelor's Degree rated two items significantly higher than did respondents with higher levels of education. The characteristic "major area of study" indicated those with a major area of study in crop production rated the importance of the item "field borders" significantly higher than with those with major areas of study in other disciplines. This finding may be due to their exposure to this topic while in school. Six topical items were

found to have significant differences in their importance when respondents were grouped by the administrative area in which they worked. These findings indicate the diversity and area-specific nature of agriculture in Iowa.

The findings seem to validate the importance of the topical items in sustainable agriculture selected for this study. Although many significant differences were found and are quite interesting, they yield very little practical information to be used in planning educational programs for agricultural extension professionals in Iowa.

Present Level of Knowledge of Respondents Regarding Sustainable Agriculture

Another important objective of this study was to determine the present level of knowledge of county-level agricultural extension professionals in Iowa regarding selected topical items in sustainable agriculture. It was observed that twelve of the topical items in sustainable agriculture received a rating of four or above. The next twenty-five items were rated between 3.00 and 3.95. The final six topical items in sustainable agriculture were rated between 2.05 and 2.98. As was reported in the importance to work scale, the item "soil testing" received the highest rating on the knowledge scale. The item with the lowest knowledge rating was "agroforestry." "Agroforestry" was also rated as the second least important topical item found on the survey. The findings indicate that county-level agricultural extension professionals in Iowa have at least some knowledge regarding the selected topical items in sustainable agriculture. As a group, the respondents rated thirty-seven of the items three or above, a rating of "some" or above in knowledge. The relatively low rating given to the topical item "agroforestry" seemed to indicate a lack of exposure on the part of the agricultural extension professional to this new agricultural innovation.

A Scheffe test located several significant statistical differences between the respondents' perceived present level of knowledge of the selected topical areas in sustainable agriculture

when grouped by different demographic characteristics. The characteristic "age" indicated that those 60 years of age and older reported a significantly higher level of knowledge than did the other age groups regarding the topical items "alternative crops" and "alternative livestock." The characteristic "years of experience" gave evidence that those with 30 or more years of experience with Iowa State University Extension rated their level of knowledge of the item "planting trees and shrubs" significantly higher than did groups with lesser amounts of work experience. This finding may be due to the land stewardship ethic which was still prevalent in agriculture some thirty years ago. The characteristic "level of education" found that those possessing a Doctoral Degree rated the item "tissue testing" significantly higher than did the other two groups with regards to their present level of knowledge. The characteristic "major area of study" indicated those with a major area of study in the social sciences rated their present level of knowledge of the items "alternative crops" and "on-farm composting" significantly lower than did the other groups. This may be due to their lack of exposure to these topics while in school. The characteristic "administrative area" showed that the item "sinkhole treatment" received a significantly higher present level of knowledge rating by those who worked in the East Central administrative area. "Pasture management" received a significantly higher knowledge rating by those who worked in the Southwest administrative area. This finding is probably due to the large number of cattle found in this geographical region of Iowa. The characteristic "additional extension duties" indicated those with three additional extension responsibilities besides agriculture rated their present level of knowledge of the items "tissue testing" and "the proper use and storage of agricultural chemicals" significantly higher than those with fewer extension responsibilities.

A t-test procedure was employed to identify any significant differences between respondents who had attended workshops or conferences in sustainable agriculture and those who had not attended workshops or conferences in sustainable agriculture regarding their

perceived level of knowledge regarding selected topical items in sustainable agriculture. Respondents who had attended workshops or conferences in sustainable agriculture reported their present level of the items "on-farm research" and "energy conservation" significantly higher than those who had not attended workshops or conferences in sustainable agriculture. This finding may be due to the recent emphasis of "on-farm research" at sustainable agriculture workshops and conferences.

The findings related to the present level of knowledge of the respondents regarding selected topical items in sustainable agriculture give evidence to support that the respondents were somewhat familiar with the topical items. Respondents were clearly more knowledgeable regarding some items as opposed to others. This finding may be due in part to the respondents' lack of exposure and/or the lack of relevance to their work.

Training Needs of Respondents in Sustainable Agriculture

One of the primary objectives of this study was to identify the training needs focused on sustainable agriculture of county-level agricultural extension professionals in Iowa. The training needs of the respondents were calculated in two ways: raw scores and weighted priority scores. The raw scores indicated that only three of the topical items in sustainable agriculture received a rating of four or above. The next thirty-four topical items were rated between 3.15 and 3.92. The remaining six items were rated between 2.53 and 2.95. The item "economic analysis of sustainable agricultural systems" received the highest rating for training needs while "sinkhole treatment" received the lowest rating. The findings seem to suggest that the respondents perceive the need for training in only three of the topical items. The findings also suggest that, due to the large number of items which were rated between 3.15 and 3.92, the respondents were either unsure of their own training needs or that the respondents were not familiar with the topical items.

The one-way analysis of variance procedure, along with a Scheffe test, was used to identify any significant statistical differences which existed regarding the respondents perceived need for training in topical items in sustainable agriculture when grouped by demographic characteristics. The characteristic "age" showed that those between the ages of 40 and 49 years rated their need for training in five items significantly higher than did those in other age groups. The characteristic "years of experience" gave evidence that those with 10 to 19 years of experience rated their need for training in several items significantly lower than did those with different amounts of experience with Iowa State University Extension. However, it must be noted that the highest need for training scores, when respondents were grouped by their years of experience with extension, were neutral at best. The characteristic "level of education" indicated that those possessing a Doctoral Degree reported a significantly lower need for training regarding the item "on-farm research." This finding may be due to the research nature of their degree. The characteristic "administrative area" indicated that respondents who worked in the East Central geographical area reported a significantly higher need for training in the items "pasture management" and "intensive short-duration grazing." A t-test indicated that those who had not attended workshops or conferences in sustainable agriculture perceived a significantly higher need for training related to the items "alternative crops", "economic analysis of sustainable agricultural systems', "surface water contamination", "proper use and storage of agricultural chemicals", and "manure management" than those who had attended workshops or conferences in sustainable agriculture.

A weighted score was calculated to determine the priority training needs of county-level agricultural extension professionals in Iowa. This method was used to formulate a training needs score for each of the selected items in sustainable agriculture based upon the importance to work scores and present level of knowledge scores of the respondents. This method of prioritizing training needs yielded findings somewhat similar in nature to the raw training need

scores. The item which was rated as having the highest priority for training was "economic analysis of sustainable agricultural systems." The item which was ranked as the lowest priority for training was "planting trees and shrubs."

Need of Respondents for Informational Materials in Sustainable Agriculture

Findings of this study related to the need for informational materials in sustainable agriculture seem to be linked quite closely with the perceived training needs of the respondents. Overall, the raw informational need scores indicate that informational material is needed regarding the item "economic analysis of sustainable agricultural systems." Seven of the topical items in sustainable agriculture received a rating of four or above. The next thirty-four topical items were rated between 3.10 and 3.91. The remaining two topical items in sustainable agriculture, "sinkhole treatment" and "agroforestry," received ratings of 2.61 and 2.89, respectively. Perhaps this finding suggests that the issue of "sinkhole treatment" is well at hand. "Agroforestry", on the other hand, is a promising recent innovation in agriculture and it could be quite possible that county-level agricultural extension professionals are not aware of its potential in Iowa. The demographic characteristic "age" indicated that those 40 to 49 years of age rated the need for informational materials significantly higher than did other age groups in regards to several items. The characteristic "level of education" found that those with Doctoral Degree's rated the need for information about "on-farm research" significantly lower than did those with either a Bachelor's Degree or a Master's Degree. The characteristic "administrative area" again found several significant differences to exist among the seven Iowa State University Extension administrative areas regarding the need for informational materials. This finding solidifies the diverse and site-specific needs of even a homogeneous agricultural state such as Iowa. When combined with the importance to work scores and present level of knowledge scores, the weighted priority informational need scores indicated a strong need for

informational materials dealing with the "economic analysis of sustainable agricultural systems." The lowest ranked priority for informational materials relating to sustainable agriculture are those materials having to do with "sinkhole treatment."

Educational Implications of the Findings of the Study

The overall goal of this study was to be able to draw implications for agricultural and extension education programs with regards to sustainable agriculture. The findings of this study indicate that the county-level agricultural extension personnel in Iowa represent a formidable educational resource for those involved with agricultural production in Iowa. As a group, they are highly educated and experienced in extension. When the respondents were grouped by several demographic variables, several statistically significant differences were located. The only practical information gained from these significant differences was when the respondents were grouped by administrative area. It was this information which showed the diverse and site-specific agricultural needs of Iowa. This information could be quite useful for planning area-specific educational programs for agricultural extension personnel.

The findings indicate a strong need for both educational programs and informational materials in the economic assessment of sustainable agricultural systems. Other items having high priority training and information needs were: tillage systems, residue management, on-farm research, manure management, and rotational grazing. The bottom-line, according to the comments of the respondents is that people are involved in farming to make a profit. They will only make changes in their current practices when they are able to clearly see a benefit to themselves or, more recently, to the environment. It is imperative that county-level agricultural extension professionals have the necessary training and informational materials to help farmers make unbiased, value-based decisions regarding the future of a sustainable agriculture in Iowa.

While there is no doubt that county-level agricultural extension professionals perceived their educational needs to be strong in several of the selected areas in sustainable agriculture, it is necessary to also examine how the respondents came to select the particular areas for which they felt they lacked adequate knowledge. Were those needs selected on the basis of a self-perceived need of the respondent or were those needs based on an analysis of site-specific community needs? Do county-level agricultural extension professionals have adequate educational preparation to conduct a community agricultural needs analysis? If not, it is imperative that they be familiarized with the needs analysis and program planning process. The criteria used for the selection of new county-level agricultural extension professionals should include the knowledge of not only these processes but also an in-depth knowledge of educational delivery and adult learning methodologies, as well as the technical knowledge in sustainable agriculture which will be required by law in 1995.

Figure 9 presents a basic program planning and delivery model which could serve as a guide for county-level agricultural professionals when deciding upon a specific plan of action. The model begins with the development of a clear organizational philosophy. Next comes the development of a clear organizational mission. Both the mission and the philosophy must be communicated throughout the organization. The members of the organization must be clear as to what guides them or no meaningful action will occur within the organization and the clientele will suffer. The next phase in this process is the organization of a specific needs assessment and analysis, which leads to the development of community priorities. Both community and organizational resources should contribute to the needs assessment and analysis process. Once the needs have been identified, the goals and action steps must be prioritized. Some allowance should also be made for alternative responses to unforeseen problems. Extension professionals must then select proper delivery methods, techniques, and technical aids. The program would then be implemented and delivered with assistance, when necessary, from

other agricultural information providers and interested farm organizations such as Practical Farmers of Iowa. After implementation, both the process and results would be evaluated both at the community and organizational levels. The process would be continuous in that needs will continually require some assessment and educational delivery systems adjusted to meet changing needs.

The study has given evidence that there are many site-specific agricultural needs in Iowa and that a "canned" program passed down from the top will not satisfy the needs of the more highly educated clientele that are available to Extension. County-level agricultural extension professionals should be facilitators of local change and not messengers of a homogeneous agricultural agenda set from the top administrative level. Extension professionals are educators and need to be skilled facilitators of education and managers of information.

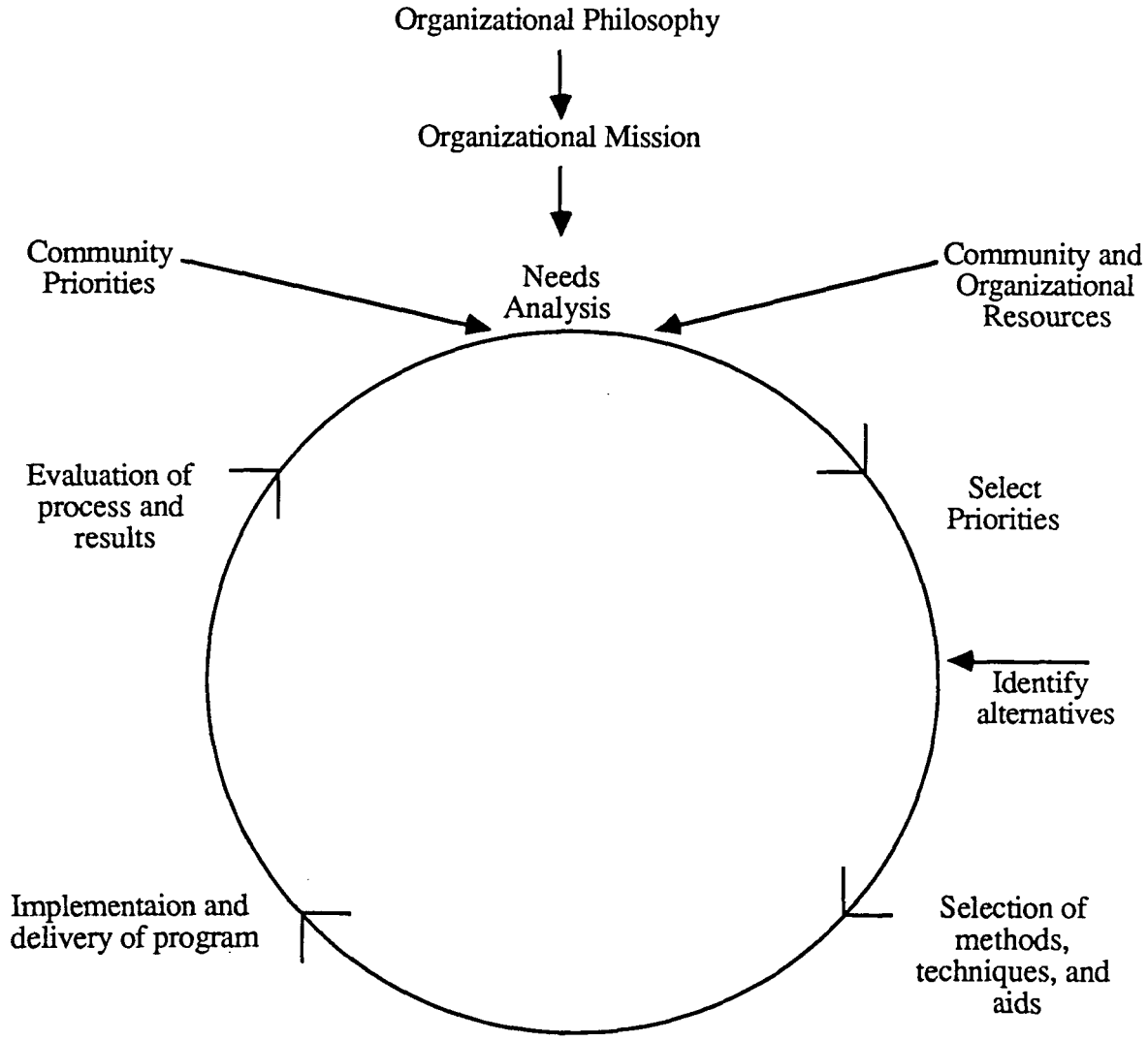

Figure 9. Community extension program planning and delivery model

CHAPTER VI. SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study was designed to determine perceptions held by county-level agricultural extension professionals in Iowa regarding training and informational needs. This chapter is organized under the following subheadings: (1) Summary; (2) Findings; (3) Conclusions; (4) Recommendations; and (5) Recommendations for Further Research.

Summary

The main purpose of this study was to identify and analyze the perceptions of county-level agricultural extension agents in Iowa regarding the need for additional training and informational needs in sustainable agriculture. A secondary purpose was to identify the implications of these perceptions to educational practice.

The specific objectives of this study were as follows:

1. To identify the level of importance of selected topical items in sustainable agriculture as perceived by county-level agricultural extension professionals in Iowa.
2. To determine the present level of knowledge of county-level agricultural extension professionals in selected topical items in sustainable agriculture.
3. To identify training needs of county-level agricultural extension professionals in sustainable agriculture.
4. To identify the need for informational materials on selected topics in sustainable agriculture as perceived by county-level agricultural extension professionals.
5. To determine the self-perceived impact of an educational intervention related to topics in sustainable agriculture according to county-level agricultural extension professionals.

6. To compare the various groups of respondents regarding their perceptions of selected topical items in sustainable agriculture and demographic factors.

The population of the study consisted of the ninety-one county-level agricultural extension professionals employed by the Iowa State University Extension Service. Since all county-level agricultural extension professionals qualified for this study, no specific sampling technique was required. The instrument, a mailed questionnaire, was sent out to the participants during the first week of December, 1991. The initial mailing resulted in the return of 70 usable questionnaires. A follow-up post card was mailed to the 21 non-respondents during the third week of December, 1991. A total of 83 questionnaires were returned for a response rate of 91 percent. The post-hoc reliability testing of the four-section data collection instrument yielded a reliability coefficient of 0.97.

The data collected from the respondents were coded and entered into the Statistical Package for the Social Sciences (SPSS) computer program at the Iowa State University Computation Center. The following statistical procedures were used to analyze the data: FREQUENCIES subprogram was used to produce means, standard deviations, frequency counts, and percentages; post-hoc reliability test, one-way analysis of variance, t-test, multiple regression, and Pearson correlation coefficient analyses; and COMPUTE statements to formulate priority training and informational need scores. These statistical procedures were chosen for their appropriateness for the research objectives.

Findings

From the analysis of the data, the following findings and conclusions were made:

1. All of the respondents in the study were male. The majority of the respondents (87.5%) were aged between 30 and 59 years. Over sixty-two percent of the respondents have worked for Extension between 10 and more than 30 years. The

largest percentage of responses (18.8%) were from the Southwest administrative area.

2. All of the respondents had at least a Bachelor's Degree. Most of the respondents (75%) had attained either a Master's or Doctoral Degree. Over 43 percent of the respondents indicated their major area of study as being education.
3. The five topical items in sustainable agriculture perceived to be the most important to the work of the respondents were: (1) Soil testing; (2) nutrient management; (3) residue management; (4) integrated pest management; and (5) erosion control.
4. Respondents were most knowledgeable about these five topical items in sustainable agriculture: (1) Soil testing; (2) proper use and storage of agricultural chemicals; (3) integrated pest management; (4) plugging abandoned wells; and (5) crop rotations.
5. The five topical items in sustainable agriculture which received the highest raw training need scores were: (1) Economic analysis of sustainable agricultural systems; (2) no-tillage; (3) residue management; (4) integrated pest management; and (5) manure management.
6. The five topical items which received the highest raw informational material needs score were: (1) Economic analysis of sustainable agricultural systems; (2) no-tillage; (3) residue management; (4) manure management; and (5) ridge tillage.
7. The five topical items receiving the highest training priority scores when training need scores were combined with importance to work scores and present level of knowledge scores were: (1) Economic analysis of sustainable agricultural systems; (2) residue management; (3) no-tillage; (4) on-farm research; and (5) erosion control.
8. The five topical items receiving the highest informational material priority scores when informational material need scores were combined with importance to work scores and present level of knowledge scores were: (1) Economic analysis of

sustainable agricultural systems; (2) residue management; (3) no-tillage; (4) on-farm research; and (5) erosion control.

Conclusions

1. These findings again verify that the respondents constitute a significant educational resource from which those involved in agriculture in Iowa can draw.
2. The majority of respondents were in agreement with the importance to their work of the topical items in sustainable agriculture.
3. Iowa State University Extension need to strengthen their efforts in providing county-level agricultural extension professionals with training and informational materials regarding the agronomic and economic aspects of sustainable agriculture.
4. The variety of responses and comments seems to indicate that there are concerns about policy directions regarding sustainable agriculture within the Iowa State University Extension Service.
5. There were many commonalties in knowledge and needs of the respondents regarding topical areas in sustainable agriculture.
6. The demographic variable "administrative area" yielded useful information regarding the site-specific agricultural concerns of the respondents. Other demographic variables reported interesting, but impractical, data.
7. Multiple regression analysis gave evidence that supports the use of two or more scores when determining training and informational needs is sustainable agriculture.
8. Workshops and conferences contribute significantly to the perceptions of respondents regarding sustainable agriculture.

Recommendations

Based upon the findings and conclusions of this study, the following recommendations were made:

1. The results of this study should be shared with the agriculture administrators of Iowa State University Extension and with other individuals responsible for planning in-service educational programs for agricultural extension personnel.
2. Iowa State University Extension needs to develop a clear policy statement pertaining to helping farmers achieve agricultural sustainability in Iowa.
3. A workshop in sustainable agriculture should be conducted for all county-level agricultural extension professionals in Iowa to become more aware of the issue of agricultural sustainability.
4. Educational programs focusing on the economic analysis of sustainable agricultural systems, tillage systems, residue management, on-farm research, manure management, and rotational grazing, should be planned for and delivered to county-level agricultural extension professionals in Iowa.
5. Informational materials regarding the economic analysis of sustainable agriculture should be developed and distributed to agricultural extension professionals.
6. Incentives should be given to county-level agricultural extension professionals for attending workshops or conferences in sustainable agriculture.
7. A review of agricultural extension publications should be conducted to ensure that the informational materials available to agricultural extension personnel and farmers contain up-to-date information related to agricultural sustainability issues.

Recommendations for Further Research

1. A more comprehensive study, involving other groups of agriculture information providers in the Midwest, should be conducted and the results compared with the findings of this study.
2. Using those topical items in sustainable agriculture which were rated the highest for training and informational needs, conduct a more specific study to determine exact needs within those topical items.
3. This study should be replicated on a regular basis to ensure that the training and informational material needs of county-level agricultural extension professionals in Iowa are met.
4. The needs assessment model developed in this study should be used again to further test its validity.

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Ol wantok long Niugini, tenk yu tru long givim dispela laik bilong wok bilong didiman. Mi hamamas no gut tru long yu bin wok wantaim mi.

My wife, Melynda, and son, Marshall, for their support, understanding, patience, and love throughout trying times. Without you, this graduate program would not have been possible. I love you.

APPENDIX A. DATA COLLECTION INSTRUMENT AND COVER LETTER

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Department of Agricultural Education and Studies
201 Curtiss Hall
Ames, Iowa 50011-1050
Administration and Graduate Programs 512 294-5904
Research and Extension programs 515 294-5872
Undergraduate Programs 515 294-6924

December 4, 1991

Dear Agricultural Extension Professional:

The creation of a sustainable agriculture is of world-wide importance. Those working towards creating a sustainable agriculture must be adequately prepared to face the challenges which lie ahead. The perceptions of Iowa Agricultural Extension Professionals regarding the identification of their own training and informational needs has become very important.

We need your help! The purpose of this study is to identify the training and informational needs of extension field personnel in creating a sustainable agriculture in Iowa. By responding to the enclosed questionnaire, you will be helping to identify training and informational needs crucial to the continued leadership role of Extension in providing assistance to Iowa farmers. This information is essential in planning and conducting appropriate in-service training programs and the preparation of informational materials for the field.

Please complete the enclosed questionnaire. **Fill in all responses.** This should take no more than 20 minutes of your time. The information you provide will be held in strict confidence, individual responses will not be available to Extension Administrators at any time. We are interested only in group data. Coding of the survey form is a means of contacting non-respondents. Upon receipt of the survey forms all code numbers will be removed. All instruments will be destroyed following analysis of the group data. The data will be used to complete a Masters degree and to help develop sustainable agriculture training programs and informational materials. Participation is voluntary. If you do not wish to participate, please return the unused questionnaire.

We hope you will take a few minutes to assist us in this important task. Please return the completed questionnaire by **December 18, 1991**. A self-addressed stamped envelope is enclosed for your convenience. We appreciate your participation and cooperation in this sustainable agriculture training needs assessment. If any questions arise regarding the completion of the survey form, please feel free to contact the undersigned individuals.

Sincerely,

David B. Wissink
Research Assistant

Robert A. Martin
Associate Professor

Perceptions of Agricultural Extension Professionals in Iowa Regarding Sustainable Agriculture

Section 1: Perceptions of Topics in Sustainable Agriculture

Instructions: In column "A" please circle the number which best represents your perception of the importance of each of the topics to your work. In column "B" please circle the number which best reflects your present level of knowledge of each topic. Please circle only one response per item.

1 = (N)one 2 = (V)ery (L)ittle 3 = (S)ome 4 = (M)oderate 5 = (H)igh

(A) Importance To Your Work					Topic	(B) Present Level of Knowledge				
N	VL	S	M	H		N	VL	S	M	H
1	2	3	4	5	Agroforestry	1	2	3	4	5
1	2	3	4	5	Field Windbreaks	1	2	3	4	5
1	2	3	4	5	Farmstead and Feedlot Windbreaks	1	2	3	4	5
1	2	3	4	5	Planting Trees and Shrubs	1	2	3	4	5
1	2	3	4	5	Alternative Crops	1	2	3	4	5
1	2	3	4	5	Alternative Livestock	1	2	3	4	5
1	2	3	4	5	Economic Analysis of Sustainable Agricultural Systems	1	2	3	4	5
1	2	3	4	5	On-Farm Research	1	2	3	4	5
1	2	3	4	5	Energy Conservation	1	2	3	4	5
1	2	3	4	5	Social Issues in Sustainable Agriculture	1	2	3	4	5
1	2	3	4	5	Surface Water Contamination	1	2	3	4	5
1	2	3	4	5	Groundwater Contamination	1	2	3	4	5
1	2	3	4	5	Proper Use and Storage of Agricultural Chemicals	1	2	3	4	5
1	2	3	4	5	Plugging Abandoned Wells	1	2	3	4	5
1	2	3	4	5	Sinkhole Treatment	1	2	3	4	5
1	2	3	4	5	Grassed Waterways	1	2	3	4	5
1	2	3	4	5	Filter Strips	1	2	3	4	5
1	2	3	4	5	Field Borders	1	2	3	4	5
1	2	3	4	5	Farmstead Assessment for Wellhead Protection	1	2	3	4	5

1 = (N)one 2 = (V)ery (L)ittle 3 = (S)ome 4 = (M)oderate 5 = (H)igh

(A) Importance To Your Work					Topic	(B) Present Level of Knowledge				
N	VL	S	M	H		N	VL	S	M	H
1	2	3	4	5	Wetland Development for Water Quality	1	2	3	4	5
1	2	3	4	5	Wetland Development for Wildlife Habitat	1	2	3	4	5
1	2	3	4	5	Nutrient Management	1	2	3	4	5
1	2	3	4	5	Manure Management	1	2	3	4	5
1	2	3	4	5	Manure Testing	1	2	3	4	5
1	2	3	4	5	Soil Testing	1	2	3	4	5
1	2	3	4	5	Tissue Testing	1	2	3	4	5
1	2	3	4	5	On-Farm Composting	1	2	3	4	5
1	2	3	4	5	Contouring	1	2	3	4	5
1	2	3	4	5	Contour Stripcropping	1	2	3	4	5
1	2	3	4	5	Contour Buffer Strips	1	2	3	4	5
1	2	3	4	5	Cover Crops	1	2	3	4	5
1	2	3	4	5	Crop Rotations	1	2	3	4	5
1	2	3	4	5	Integrated Pest Management	1	2	3	4	5
1	2	3	4	5	Intercropping	1	2	3	4	5
1	2	3	4	5	Erosion Control	1	2	3	4	5
1	2	3	4	5	Narrow Stripcropping	1	2	3	4	5
1	2	3	4	5	Residue Management	1	2	3	4	5
1	2	3	4	5	No-till	1	2	3	4	5
1	2	3	4	5	Mulch Till	1	2	3	4	5
1	2	3	4	5	Ridge Till	1	2	3	4	5

1 = (N)one 2 = (V)ery (L)ittle 3 = (S)ome 4 = (M)oderate 5 = (H)igh

(A) Importance To Your Work					Topic	(B) Present Level of Knowledge				
N	VL	S	M	H		N	VL	S	M	H
1	2	3	4	5	Pasture Management	1	2	3	4	5
1	2	3	4	5	Intensive Short-Duration Grazing	1	2	3	4	5
1	2	3	4	5	Warm Season Grasses	1	2	3	4	5

END SECTION 1

Section 2: Need for Additional Training and Informational Materials.

INSTRUCTIONS: In column "C" please circle the number which best reflects your personal need for additional training in each of the topics. In column "D" please circle the number which best reflects your personal opinion regarding the need for additional informational materials on each topic. Please circle only one response in each of the columns for each topical area.

1 = (S)trongly (D)isagree 2 = (D)isagree 3 = (N)eutral 4 = (A)gree 5 = (S)trongly (A)gree

(C) Need for Additional Training					Topic	(D) The Degree To Which You Feel Informational Material Is Needed				
SD	D	N	A	SA		SD	D	N	A	SA
1	2	3	4	5	Agroforestry	1	2	3	4	5
1	2	3	4	5	Field Windbreaks	1	2	3	4	5
1	2	3	4	5	Farmstead and Feedlot Windbreaks	1	2	3	4	5
1	2	3	4	5	Planting Trees and Shrubs	1	2	3	4	5
1	2	3	4	5	Alternative Crops	1	2	3	4	5
1	2	3	4	5	Alternative Livestock	1	2	3	4	5
1	2	3	4	5	Economic Analysis of Sustainable Agricultural Systems	1	2	3	4	5
1	2	3	4	5	On-Farm Research	1	2	3	4	5
1	2	3	4	5	Energy Conservation	1	2	3	4	5
1	2	3	4	5	Social Issues in Sustainable Agriculture	1	2	3	4	5
1	2	3	4	5	Surface Water Contamination	1	2	3	4	5
1	2	3	4	5	Groundwater Contamination	1	2	3	4	5

1 = (S)trongly (D)isagree 2 = (D)isagree 3 = (N)eutral 4 = (A)gree 5 = (S)trongly (A)gree

(C) Need for Additional Training					Topic	(D) The Degree To Which You Feel Informational Material Is Needed				
SD	D	N	A	SA		SD	D	N	A	SA
1	2	3	4	5	Proper Use and Storage of Agricultural Chemicals	1	2	3	4	5
1	2	3	4	5	Plugging Abandoned Wells	1	2	3	4	5
1	2	3	4	5	Sinkhole Treatment	1	2	3	4	5
1	2	3	4	5	Grassed Waterways	1	2	3	4	5
1	2	3	4	5	Filter Strips	1	2	3	4	5
1	2	3	4	5	Field Borders	1	2	3	4	5
1	2	3	4	5	Farmstead Assessment for Wellhead Protection	1	2	3	4	5
1	2	3	4	5	Wetland Development for Water Quality	1	2	3	4	5
1	2	3	4	5	Wetland Development for Wildlife Habitat	1	2	3	4	5
1	2	3	4	5	Nutrient Management	1	2	3	4	5
1	2	3	4	5	Manure Management	1	2	3	4	5
1	2	3	4	5	Manure Testing	1	2	3	4	5
1	2	3	4	5	Soil Testing	1	2	3	4	5
1	2	3	4	5	Tissue Testing	1	2	3	4	5
1	2	3	4	5	On-Farm Composting	1	2	3	4	5
1	2	3	4	5	Contouring	1	2	3	4	5
1	2	3	4	5	Contour Stripcropping	1	2	3	4	5
1	2	3	4	5	Contour Buffer Strips	1	2	3	4	5
1	2	3	4	5	Cover Crops	1	2	3	4	5
1	2	3	4	5	Crop Rotations	1	2	3	4	5
1	2	3	4	5	Integrated Pest Management	1	2	3	4	5
1	2	3	4	5	Intercropping	1	2	3	4	5
1	2	3	4	5	Erosion Control	1	2	3	4	5

1 = (S)trongly (D)isagree 2 = (D)isagree 3 = (N)eutral 4 = (A)gree 5 = (S)trongly (A)gree

(C) Need for Additional Training					Topic	(D) The Degree To Which You Feel Informational Material Is Needed				
SD	D	N	A	SA		SD	D	N	A	SA
1	2	3	4	5	Narrow Stripcropping	1	2	3	4	5
1	2	3	4	5	Residue Management	1	2	3	4	5
1	2	3	4	5	No-till	1	2	3	4	5
1	2	3	4	5	Mulch Till	1	2	3	4	5
1	2	3	4	5	Ridge Till	1	2	3	4	5
1	2	3	4	5	Pasture Management	1	2	3	4	5
1	2	3	4	5	Intensive Short-Duration Grazing	1	2	3	4	5
1	2	3	4	5	Warm Season Grasses	1	2	3	4	5

END SECTION 2

Section 3: Demographic Information.

Instructions: Please circle, or place in the space provided, the appropriate response.

A. Your gender is:

1. Female
2. Male

B. Your age in years is: _____

C. Number of years employed by Extension _____

D. Your educational level is:

1. High School
2. Bachelors
3. Masters
4. Doctoral

E. Major area of study for your highest degree attained:_____

F. Administrative Area in which you work:

1.	Southwest	4.	North Central	7.	Northeast
2.	East Central	5.	Southeast		
3.	Central	6.	Northwest		

G. In addition to agriculture, what other extension duties do you have? Please circle all that apply.

1.	County Director	3.	Home Economics
2.	4H and Youth	4.	Community Resource Development

H. Have you attended any workshops or conferences on sustainable agriculture? If yes, what was the name of the most recent conference or workshop, and when and where was it held?

1. Yes _____

_____

2. No

I. Are you interested in receiving a summary of the results of this study?

1. Yes
2. No

J. Comments on the role of Extension providing leadership in the field of sustainable agriculture, topics in sustainable agriculture omitted, or general comments regarding this questionnaire:

_____

_____

_____

_____

THANK YOU FOR YOUR COOPERATION

PLEASE RETURN BY **DECEMBER 18, 1991** IN THE ENCLOSED ENVELOPE TO:

David Wissink
Department of Agricultural Education & Studies
223 Curtiss Hall
Iowa State University
Ames, IA 50011

APPENDIX B. REMINDER POSTCARD

December 18, 1991

Dear Agricultural Extension Professional:

Recently you received a questionnaire concerning your perceptions regarding sustainable agriculture. Please fill out the survey form and return it as soon as possible. If you prefer not to participate, please return the blank questionnaire in the stamped envelope provided. If you have misplaced the questionnaire, please contact our office and we will provide you with a new one.

Thank you for your cooperation.

Sincerely,

David B. Wissink
Research Assistant
(515) 294-0901

Robert A. Martin
Associate Professor
(515) 294-0896

APPENDIX C. HUMAN SUBJECTS RESEARCH APPROVAL FORM

Checklist for Attachments and Time Schedule

The following are attached (please check):

12. [X] Letter or written statement to subjects indicating clearly:
    a) purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see Item 17)
    c) an estimate of time needed for participation in the research and the place
    d) if applicable, location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, note when and how you will contact subjects later
    g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. [ ] Consent form (if applicable)

14. [ ] Letter of approval for research from cooperating organizations or institutions (if applicable)

15. [X] Data-gathering instruments

16. Anticipated dates for contact with subjects:

First Contact	Last Contact
September 7, 1991	October 14, 1991
Month / Day / Year	Month / Day / Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

October 14, 1991
Month / Day / Year

18. Signature of Departmental Executive Officer | Date | Department or Administrative Unit

8/13/9 [signature] [illegible] [illegible]

19. Decision of the University Human Subjects Review Committee:

X Project Approved ___ Project Not Approved ___ No Action Required

Patricia M. Keith — Name of Committee Chairperson
8/13/91 — Date
[signature] — Signature of Committee Chairperson

APPENDIX D. T-TEST TABLES

Table D1. Means, standard deviations, and t-values of the perceived importance of selected topical items in sustainable agriculture to the work of the respondents when grouped by their having previously attended conferences or workshops in sustainable agriculture.

Item	Yes		No		t-value
	n	Mean[a] S.D.	n	Mean[a] S.D.	
Agroforestry	58	2.41 0.88	16	2.06 0.93	1.40
Field windbreaks	59	2.98 0.92	16	2.88 0.50	0.62
Farmstead and feedlot windbreaks	59	3.66 0.76	16	3.75 0.96	0.43
Planting trees and shrubs	59	3.75 0.83	16	3.75 0.86	-0.02
Alternative crops	58	3.40 0.90	16	3.50 0.82	-0.42
Alternative livestock	59	3.10 0.92	16	3.13 0.89	-0.09
Economic analysis of sustainable agricultural systems	59	4.10 0.87	16	4.06 0.85	0.16
On-farm research	58	3.91 0.96	16	3.75 0.78	0.63
Energy conservation	59	3.59 0.85	16	3.63 0.72	-0.14
Social issues in sustainable agriculture	59	3.39 0.89	16	3.50 0.97	-0.43
Surface water contamination	59	4.10 0.80	16	4.38 0.50	-1.68
Groundwater contamination	59	4.27 0.72	16	4.19 0.83	0.40

[a]1 = None; 2 = Very Little; 3 = Some; 4 = Moderate; and 5 = High

Table D1. Continued

Proper use and storage of agricultural chemicals	59	4.44 0.60	16	4.19 0.91	1.05
Plugging abandoned wells	59	4.08 0.82	16	4.25 0.68	-0.74
Sinkhole treatment	59	2.32 1.33	16	2.06 1.12	0.71
Grassed waterways	59	3.98 0.94	16	4.00 0.82	-0.07
Filter strips	59	3.85 0.96	16	3.88 0.81	-0.10
Field borders	58	3.72 0.99	16	3.69 0.95	0.13
Farmstead assessment for wellhead protection	58	3.40 1.01	16	3.13 0.72	1.01
Wetland development for water quality	58	3.00 0.96	16	3.31 0.70	-1.22
Wetland development for wildlife habitat	59	2.85 1.04	16	3.00 0.73	-0.56
Nutrient management	59	4.51 0.63	16	4.63 0.62	-0.66
Manure management	59	4.32 0.71	16	4.56 0.63	-1.24
Manure testing	59	3.83 0.83	16	3.50 0.90	1.39
Soil testing	59	4.59 0.60	16	4.50 0.63	0.55
Tissue testing	59	3.41 0.95	16	3.31 0.87	0.36
On-farm composting	59	2.88 0.97	16	2.56 0.73	1.23
Contouring	59	3.88 1.02	16	3.69 1.08	0.67

Table D1. Continued

Contour stripcropping	59	3.71 1.07	16	3.63 0.96	0.29
Contour buffer strips	59	3.63 1.05	16	3.56 0.89	0.23
Cover crops	59	3.56 0.99	16	3.50 0.97	0.21
Crop rotations	59	4.24 0.86	16	4.19 0.75	0.21
Integrated pest management	59	4.49 0.65	16	4.44 0.81	0.28
Intercropping	59	3.20 0.85	16	2.81 0.54	1.75
Erosion control	59	4.49 0.68	16	4.38 0.81	0.58
Narrow stripcropping	59	3.24 0.92	16	3.19 1.05	0.19
Residue mangement	59	4.61 0.62	16	4.31 0.79	1.61
No tillage	59	4.39 0.79	16	4.19 0.75	0.92
Mulch tillage	59	4.05 0.88	16	3.94 0.85	0.46
Ridge tillage	59	3.85 1.00	16	3.75 1.07	0.34
Pasture management	59	3.90 0.96	16	3.69 1.14	0.75
Intensive short-duration grazing	59	3.69 1.00	16	3.50 0.97	0.69
Warm season grasses	59	3.49 0.90	16	3.19 1.11	1.14

Table D2. Means, standard deviations, and t-values of the respondents' perceived present level of knowledge of selected topical items in sustainable agriculture when grouped by their having previously attended conferences or workshops in sustainable agriculture.

	Yes		No		
Item	n	Mean S.D.	n	Mean[a] S.D.	t-value
Agroforestry	58	2.47 1.03	16	2.00 0.73	1.69
Field windbreaks	59	3.47 1.00	16	3.13 0.72	1.30
Farmstead and feedlot windbreaks	59	3.85 0.91	16	3.44 0.73	1.67
Planting trees and shrubs	59	4.20 0.78	16	3.88 0.81	1.48
Alternative crops	58	3.28 0.72	16	2.94 0.77	1.64
Alternative livestock	59	2.83 0.85	16	2.75 0.76	0.34
Economic analysis of sustainable agricultural systems	59	3.26 0.87	16	3.06 0.77	0.82
On-farm research	58	3.59 0.89	16	3.06 0.68	2.21*
Energy conservation	59	3.54 0.88	16	3.00 0.63	2.31*
Social issues in sustainable agriculture	58	3.24 0.88	16	3.06 0.68	0.73
Surface water contamination	59	4.03 0.67	16	4.06 0.50	-0.16
Groundwater contamination	59	4.20 0.64	16	3.94 0.57	1.51

[a]1 = None; 2 = Very Little; 3 = Some; 4 = Moderate; and 5 = High

*$p \leq 0.05$

Table D2. Continued

Proper use and storage of agricultural chemicals	59	4.54 0.64	16	3.94 0.57	1.51
Plugging abandoned wells	59	4.24 0.70	16	4.50 0.52	-1.39
Sinkhole treatment	59	2.86 1.21	16	2.69 1.25	0.55
Grassed waterways	59	3.97 0.85	16	3.63 0.50	2.04*
Filter strips	59	3.78 0.95	16	3.38 0.62	1.61
Field borders	58	3.74 0.93	16	3.31 0.70	1.71
Farmstead assessment for wellhead protection	57	3.14 1.16	16	2.88 1.31	0.79
Wetland development for water quality	58	2.75 0.96	16	2.63 1.09	0.43
Wetland development for wildlife habitat	59	2.69 0.95	16	2.63 0.96	0.26
Nutrient management	59	4.24 0.75	16	4.31 0.60	-0.37
Manure management	59	4.19 0.73	16	3.88 0.89	1.44
Manure testing	58	3.60 0.79	16	3.31 0.87	1.27
Soil testing	59	4.61 0.59	16	4.31 0.79	1.66
Tissue testing	58	3.10 0.93	16	2.88 0.89	0.88
On-farm composting	59	3.07 1.05	16	2.56 1.03	1.72
Contouring	59	4.02 0.84	16	3.63 0.89	1.64

Table D2. Continued

Contour stripcropping	59	3.83 0.85	16	3.56 0.81	1.12
Contour buffer strips	59	3.58 0.93	16	3.38 0.81	0.79
Cover crops	59	3.56 0.88	16	3.63 1.03	-0.26
Crop rotations	59	4.29 0.77	16	4.19 0.66	0.48
Integrated pest management	59	4.47 0.68	16	4.25 0.78	1.14
Intercropping	59	2.97 0.89	16	3.06 0.93	-0.38
Erosion control	59	4.07 0.83	16	3.94 0.68	0.58
Narrow stripcropping	59	3.08 0.93	16	2.88 0.89	0.81
Residue mangement	59	4.20 0.71	16	3.81 0.66	1.97
No tillage	59	4.02 0.73	16	3.75 0.68	1.31
Mulch tillage	59	3.71 0.89	16	3.44 0.81	1.11
Ridge tillage	59	3.64 0.94	16	3.38 0.62	1.08
Pasture management	59	3.86 0.86	16	3.63 1.09	0.93
Intensive short-duration grazing	59	3.47 0.86	16	3.13 1.03	1.39
Warm season grasses	59	3.51 0.92	16	3.38 1.03	0.50

Table D3. Means, standard deviations, and t-values of the respondents perceived need for addtional training regarding selected topical items in sustainable agriculture when grouped by their having previously attended conferences or workshops in sustainable agriculture.

Item	Yes		No		t-value
	n	Mean S.D.	n	Mean[a] S.D.	
Agroforestry	58	2.67 1.07	16	2.31 0.87	1.24
Field windbreaks	59	2.85 0.92	16	3.00 0.89	-0.63
Farmstead and feedlot windbreaks	59	3.10 0.88	16	3.38 1.20	-1.01
Planting trees and shrubs	59	2.80 1.00	16	3.13 1.26	-1.10
Alternative crops	58	3.68 0.84	16	4.19 0.54	-2.29*
Alternative livestock	59	3.63 0.87	16	4.06 0.68	-1.85
Economic analysis of sustainable agricultural systems	59	4.19 0.92	16	4.69 0.48	-2.96**
On-farm research	59	3.64 0.89	16	3.69 0.87	-0.17
Energy conservation	58	3.28 0.81	16	3.75 0.93	-2.00*
Social issues in sustainable agriculture	59	3.61 0.93	16	3.88 1.09	-0.98
Surface water contamination	59	3.10 0.92	16	3.81 0.91	-2.74*

[a]1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; and 5 = Strongly Agree

**$p \leq 0.01$

*$p \leq 0.05$

Table D3. Continued

Groundwater contamination	59	3.29 0.98	16	3.81 0.98	-1.89
Proper use and storage of agricultural chemicals	58	3.03 0.96	16	3.63 1.09	-2.13*
Plugging abandoned wells	59	2.85 0.87	16	3.06 1.06	-0.84
Sinkhole treatment	59	2.58 1.09	16	2.19 0.98	1.29
Grassed waterways	59	3.15 0.91	16	3.44 0.89	-1.12
Filter strips	59	3.24 0.95	16	3.44 0.89	-0.75
Field borders	59	3.12 1.00	16	3.44 0.89	-1.15
Farmstead assessment for wellhead protection	58	3.29 0.98	16	2.88 1.15	1.44
Wetland development for water quality	58	3.24 0.97	16	3.44 0.89	-0.74
Wetland development for wildlife habitat	59	3.07 1.05	16	3.31 1.01	-0.83
Nutrient management	58	3.67 0.94	16	4.19 0.91	-1.95
Manure management	59	3.71 0.81	16	4.31 0.79	-2.64**
Manure testing	59	3.37 0.87	16	3.63 0.81	-1.04
Soil testing	59	3.17 1.07	16	3.63 0.89	-1.56
Tissue testing	59	3.32 0.99	16	3.44 0.89	-0.42
On-farm composting	59	2.86 0.96	16	3.00 0.89	-0.51

Table D3. Continued

Contouring	59	3.08 0.93	16	3.25 1.00	-0.62
Contour stripcropping	59	3.10 0.94	16	3.38 0.96	-1.03
Contour buffer strips	59	3.14 0.97	16	3.31 0.95	-0.65
Cover crops	59	3.44 0.97	16	3.25 0.93	0.70
Crop rotations	59	3.41 0.97	16	3.56 0.81	-0.56
Integrated pest management	58	3.86 0.91	16	4.13 0.81	-1.05
Intercropping	59	3.44 0.88	16	3.38 1.03	0.26
Erosion control	59	3.53 0.90	16	4.00 0.89	-1.88
Narrow stripcropping	59	3.36 0.92	16	3.50 0.82	-0.57
Residue mangement	58	3.90 0.83	16	4.19 0.98	-1.19
No tillage	58	4.00 0.80	16	4.06 0.85	-0.27
Mulch tillage	58	3.64 0.91	16	4.00 0.89	-1.41
Ridge tillage	58	3.83 0.84	16	3.81 0.91	0.06
Pasture management	57	3.82 0.89	16	4.00 0.82	-0.71
Intensive short-duration grazing	57	3.86 0.99	16	3.75 1.07	0.39
Warm season grasses	57	3.63 0.88	16	3.25 1.00	1.49

Table D4. Means, standard deviations, and t-values of the respondents perceived need for informational materials regarding selected topical items in sustainable agriculture when grouped by their having previously attended conferences or workshops in sustainable agriculture.

Item	Yes		No		t-value
	n	Mean S.D.	n	Mean[a] S.D.	
Agroforestry	58	2.91 1.14	16	2.63 0.96	0.92
Field windbreaks	59	3.05 0.96	16	3.19 0.75	-0.53
Farmstead and feedlot windbreaks	59	3.31 0.90	16	3.38 0.81	-0.28
Planting trees and shrubs	59	3.08 0.95	16	3.44 1.09	-1.27
Alternative crops	59	3.73 1.01	16	4.19 0.75	-1.68
Alternative livestock	59	3.78 0.95	16	4.13 0.62	-1.38
Economic analysis of sustainable agricultural systems	59	4.34 0.80	16	4.63 0.50	-1.35
On-farm research	58	3.85 1.00	16	3.81 0.91	0.13
Energy conservation	58	3.50 0.82	16	3.88 0.89	-0.14
Social issues in sustainable agriculture	59	3.61 0.97	16	3.94 1.06	-1.18
Surface water contamination	59	3.46 0.90	16	3.69 0.79	-0.93
Groundwater contamination	59	3.51 0.92	16	3.75 1.00	-0.92

[a]1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; and 5 = Strongly Agree

Table D4. Continued

Proper use and storage of agricultural chemicals	58	3.26 1.45	16	3.75 1.00	-1.56
Plugging abandoned wells	59	3.05 1.04	16	3.38 1.02	-1.07
Sinkhole treatment	59	2.53 1.17	16	2.63 1.26	-0.30
Grassed waterways	59	3.34 0.92	16	3.63 0.96	-1.09
Filter strips	59	3.41 0.99	16	3.63 0.89	-0.80
Field borders	59	3.39 0.95	16	3.63 0.96	-0.88
Farmstead assessment for wellhead protection	59	3.46 0.95	16	3.25 1.13	0.74
Wetland development for water quality	58	3.36 1.02	16	3.69 0.95	-1.15
Wetland development for wildlife habitat	58	3.26 1.05	16	3.50 1.01	-0.81
Nutrient management	59	3.81 0.92	16	3.94 0.93	-0.48
Manure management	59	3.98 0.75	15	4.20 0.86	-0.97
Manure testing	59	3.71 0.89	16	3.63 1.15	0.32
Soil testing	59	3.42 1.10	16	3.56 1.03	-0.45
Tissue testing	59	3.56 0.99	16	3.69 1.08	-0.45
On-farm composting	59	3.14 1.00	16	3.44 0.89	-1.10
Contouring	59	3.25 0.90	16	3.56 1.03	-1.18

Table D4. Continued

Contour stripcropping	59	3.31 0.90	16	3.69 0.95	-1.50
Contour buffer strips	59	3.27 0.93	16	3.63 0.89	-1.37
Cover crops	59	3.56 1.01	16	3.56 0.96	-0.01
Crop rotations	57	3.63 0.96	16	3.81 0.91	-0.68
Integrated pest management	59	3.83 0.89	16	4.13 1.09	-1.12
Intercropping	59	3.46 0.90	16	3.38 0.96	0.32
Erosion control	59	3.71 0.89	16	4.13 0.96	-1.62
Narrow stripcropping	59	3.31 0.95	16	3.56 0.81	-0.99
Residue mangement	58	4.09 0.78	16	4.44 0.89	-1.55
No tillage	58	4.16 0.70	16	4.25 1.00	-0.44
Mulch tillage	58	3.74 0.87	16	4.19 1.05	-1.74
Ridge tillage	58	3.98 0.78	16	4.25 0.93	-1.16
Pasture management	58	4.02 0.91	16	4.00 0.97	0.07
Intensive short-duration grazing	58	4.00 0.94	16	4.06 1.12	-0.23
Warm season grasses	58	3.66 1.00	16	3.63 1.09	0.10