MICHIGAN SCHOOL BASED AGRICULTURE EDUCATORS: DETERMINING ECOLOGICAL PARADIGM, AGRICULTURAL PARADIGM, KNOWLEDGE OF SUSTAINABLE AGRICULTURE, AND PRIORITIZING INSTRUCTIONAL NEEDS OF SUSTAINABLE AGRICULTURAL PRACTICES

By

Rebecca Wittman

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Community, Agriculture, Recreation, and Resource Studies - Master of Science

2015

ABSTRACT

MICHIGAN SCHOOL BASED AGRICULTURE EDUCATORS: DETERMINING ECOLOGICAL PARADIGM, AGRICULTURAL PARADIGM, KNOWLEDGE OF SUSTAINABLE AGRICULTURE, AND PRIORITIZING INSTRUCTIONAL NEEDS OF SUSTAINABLE AGRICULTURAL PRACTICES

By

Rebecca Wittman

The necessary skill-sets and knowledges are changing for those entering these food, fiber, and energy industries to include an understanding of sustainable agriculture (SA). Little research exists on Michigan school based agricultural educators': 1) beliefs, attitudes, and knowledge of SA; 2) instruction of SA; or 3) instructional needs on sustainable agricultural practices (SAP).

The purpose of this exploratory study was to: 1) determine the demographic composition of Michigan SBAE educators; 2) establish a baseline of their attitudes, beliefs, definitions of SA, and knowledge of SA; and 3) identify and prioritize their in-service needs on SAP instruction using a Borich Needs Assessment Model.

This was a descriptive/correlational research study. SBAE educators overall held a slightly eco-centric worldview, believed moderately in an alternative agricultural paradigm, and demonstrated a strong understanding of SA as defined by the USDA. Their definitions lacked a greater understanding of a complete SA system; they generally conceived of SA as having mostly ecological value. SBAE educators thought the 12 agricultural competencies were important, but considered themselves as lacking full understanding of a majority of them. SBAE educators prioritized the following competencies: 1) Integrated Pest Management, 2) Management Intensive Grazing, and 3) Water Quality. The findings of this exploratory study will inform future research. With further empirical support, the findings can be used to shape secondary agriscience curricula and in-service programming regarding SA and SAP instruction.

ACKNOWLEDGEMENTS

I have been incredibly fortunate to be surrounded by an abundantly supportive community while completing my thesis. Most importantly, I'd like to thank my advisor, Dr. Matt Raven, for his patience, perspective, and encouragement; he continued to seek ways to reach out to me. In addition, Dr. Matt Raven and Dr. Jeno Rivera offered me graduate assistantships, which funded my program; I am extremely lucky and grateful for the extensive financial support. Thank you to my committee members, Dr. Mike Everett and Dr. Kimberly Chung, for their critical feedback, encouragement, and support throughout the process! Thank you as well to the GACC and to Department Chair Dr. Michael Kaplowitz for their exceedingly generous Graduate Office Fellowships! Finally, a thank you to Dr. Kaplowitz for his patience while I was finalizing my thesis.

I'd like to acknowledge the subjects who took the time to participate and provide their insight. With such limited research on this topic, their participation was incredibly valuable to providing both baseline data upon which additional studies can build and by informing in-service how to better support them.

There are not enough words to express my deep gratitude to my family and friends in CARRS and across the country for their invaluable support and patience. You all have been my rock over the course of this process!

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

Introduction

Michigan’s agriculture and natural resource based sectors celebrated economic vigor following the 2008 national and state recessions while the remainder of the state’s economy, particularly in manufacturing, suffered significant losses. An economic impact study illustrated that Michigan’s production of food, fiber, and energy underwent an impressive economic increase of 45.9% from 2004 to 2010 (Knudson & Peterson, 2012). In response to the report, Michigan Farm Bureau President Wayne H. Wood argued, "This is… solid proof that Michigan's farmers are a vital component to the long-term stability of our state's economy (Nagel, 2012, p. 30).” Interestingly, the scope of the state economic impact study did not include direct sales such as community supported agriculture (CSA) or farm markets (Knudson & Peterson, 2012). These forms of direct sale are manifestations of local food systems and in and of themselves are also “known to be popular and rapidly growing segments of the industry” particularly within Michigan (Nagel, 2012, p. 30). These examples demonstrate how Michigan’s abundant resource base and solid reputation as a national leader in regional and local food systems thinking has driven the state’s economic recovery and how they can potentially lead its economic future. This also positions Michigan to fill a powerful leadership role at the national level since agriculture is the most valuable sector to the national economy (NRC, 2009).

One manifestation of Michigan’s leadership in regional and local food systems thinking is the Michigan Good Food Charter (2010); its mission is to create an integrated, localized, food system. Its charter represents the view of a collection of businesses, organizations, and policy-makers working together to bring about a cohesive transformation toward localized food systems. Within this collective vision are means to achieve their goals in ways that are sustainable, just, and economically viable for Michigan's economy. Since 59% of Michiganders statewide are food insecure, one goal expects a doubling of Michiganders' access to healthy, fresh, and local food across the state. An additional goal establishes that by 2020, twenty percent of food products purchased by state institutions will be sourced within the state. Two specific priorities in the Charter's agenda are: 1) providing school-based and informal educational opportunities for youth to develop entrepreneurial skills, specifically around good food and supporting the economy of the local community; and 2) "incorporate good food education in the pre-K through 12th curriculum for all Michigan students (Michigan Good Food Charter, 2010)."

The Michigan Good Food Charter is a manifestation of how the state's agriculture and the natural resources sectors are addressing timely concerns around sustainable food and fiber production. "Sustainable agriculture (SA) is both a philosophy and a system of farming. It is rooted in a set of values that reflects an awareness of both ecological and social realities, and a commitment to respond appropriately to that awareness (MacRae, Henning, & Hill, 1993, p. 22)." Beus and Dunlap (1991) contrast this with the concept of conventional agricultural which promotes economic efficiency through concentration, specialization, mechanized agriculture, and biotechnology; it has been the dominate system of agricultural production for decades.

Our national agricultural and natural resource sectors have the opportunity to be at the forefront in addressing the sustainable food and fiber production problems domestically and internationally (NRC, 2009). "The search for solutions to meet urgent food, fiber, and fuel needs is complicated by issues that are beyond the control of a single nation or even one economic sector (NRC, 2009, p. 2)." This includes managing to feed the world population, negotiating production with climate change, and managing resources for food and biofuel. For agriculture to sustain itself, it must adapt (NCAE, 2009). Agricultural education - at the post-secondary level and secondary level - must in turn adapt to meet the demands of the 21^{st} century and strengthen the vitality of the agricultural sector (NRC, 2009).

There are numerous examples of how societal changes are directly altering the expectations of students in school based agricultural education (SBAE) programs. Funded by the National FFA Foundation, the National Council for Agricultural Education (The Council) developed the National AFNR Career Cluster Content Standards. These standards direct SBAE nationally from grade 9 to grade 14 (NCAE, 2009). SBAE educators have been certified to instruct formal agricultural education at the secondary level. The Council promotes itself as the leading advocate for "shaping and strengthening" national SBAE; the standards reflect its mission to identify and resolve contemporary national issues. As representatives of SBAE, the Council provided a set of national standards, measures, performance elements, and performance indicators to support SBAE instruction in a way that is relevant to its needs. The standards align with national academic standards and provide a usable reference to them (NCAE, 2009).

The Council's National AFNR Career Cluster Content Standards provide eight career pathways opportunities, technical skills, and relevant knowledge to support success in that industry. Embedded throughout the standards are the principles of sustainability. For example, in Plant Systems instruction, one performance indicator is "Apply principles and practices of SA to plant production" (NCAE, 2009, p. 53). Students advance from having the ability to describe SA and its respective goals, to comparing and contrasting the ecologic effects of different sustainable agricultural practices (SAP) to traditional practices, to drafting and implementing a production plan using SAP. SAP are the technical processes that are associated with the production cycle which are possible methods to help mitigate social, economic, and environmental impacts.

The expectations of agricultural students participating in career and technical education are also changing, one example being the national program Career Technical Education (CTE) (Evolution of Career Clusters Knowledge and Skills and the Common Career Technical Core, n.d.). CTE consists of 16 Career Clusters and the associated knowledge and skill statements crucial for success as identified by industry representatives; one Career Cluster focuses on Agriculture, Food, and Natural Resources (Evolution of Career Clusters Knowledge and Skills and the Common Career Technical Core, n.d.). “All states… rely on this [federal] funding to support secondary, postsecondary, and adult CTE programs (“CTE At a Glance,” n.d., para. 6).” The CTE framework targets three areas: 1) knowledge and skill statements; 2) Common Career Technical Core Standards (CCTC); and 3) Green/Sustainability Standards; the latter two were introduced mid-2012.

The newly introduced CCTC standards, created by a collection of ANFR personnel, educators, and businesses, are a set of voluntary standards which explicitly list the identified knowledge and skills needed for success in each Career Clusters (National Association of State Directors of Career Technical Education Consortium/National Career Technical Education Foundation, 2012). There are six CCTC standards for the Career Cluster AFNR. One standard calls for students to be able to “analyze the interaction among AFNR systems in the production, processing, and management of food, fiber and fuel and the sustainable use of natural resources” in order to succeed in a global economy (National Association of State Directors of Career Technical Education Consortium/National Career Technical Education Foundation, 2012, p. 4). The Natural Resources Systems Career Pathway under this Career Cluster specifically expects that students can process and produce natural resources sustainably (National Association of State Directors of Career Technical Education Consortium/National Career Technical Education

Foundation, 2012). Even among the Career Ready Practices included in the CTCC is a set of universal, soft skills that instructors are expected to instill in their students. One of the soft skills is the ability to make decisions weighing environment, social, and economic impacts (National Association of State Directors of Career Technical Education Consortium/National Career Technical Education Foundation, 2012).

Funded by the Department of Education, the Green and Sustainability standards were created to assist CTE students to remain competitive in response to increasing global green related economic activity (Evolution of Career Clusters Knowledge and Skills and the Common Career Technical Core, n.d.).The new standards complement the existing 16 Career Clusters of the National Career Cluster Framework by introducing new Knowledges and Skill Statements needed for that career (Evolution of Career Clusters Knowledge and Skills and the Common Career Technical Core, n.d.).These standards encourage skills such as: 1) decision-making regarding social, economic, and environmental impacts; 2) thinking globally and locally; 3) managing natural resources; and 4) reflecting on how the agricultural sector is changing in response to the need for "green" (Evolution of Career Clusters Knowledge and Skills and the Common Career Technical Core, n.d.). In addition, specific areas that are expected to have a higher or more diverse need of "green workers," such as agriculture and natural resources, have their own set of standards. Again, the inclusion of these new standards as of mid-2012, reflect agriculture's need for professionals with these skills sets, knowledge, values and beliefs.

The pressure to adapt is also felt at the undergraduate agricultural level within Colleges of Agriculture, particularly at land-grant universities. Questions exist about the preparation of agricultural students for careers that consider sustainability in regards to the food, fiber, and energy sectors. In response to criticisms since the 1990's that agricultural programs need to modernize their conceptions of food systems and become more interdisciplinary, land-grant universities are looking to integrate SA principles. Even still, these existing programs continue to perpetuate a production system that is challenged by economic, social, and ecological consequences. Enrollment in undergraduate agricultural programs has declined over the past several decades (McCallister, Lee, & Mason, 2005; Myers, Breja, & Dyer, 2004; Russell, 1993), which has universities reducing departmental faculty (Esters, 2007). Borsari, Vidrine, and Doherty (2002) argue that to incorporate a SA approach into the curriculum, content changes are not sufficient; systemic changes are necessary.

Theoretical Framework

Beus and Dunlap (1991) theorized that a separate and disparate paradigm had emerged from the dominant paradigm of conventional agriculture. A paradigm can be defined as "a prominent worldview, model or frame of reference through which individuals, or collectively, a society interprets the meaning of the external world (Beus & Dunlap, 1994a; Pirages & Ehrlick, 1974, p. 43)." Beus and Dunlap (1991) suggested that proponents of SA subscribe to a fundamentally different paradigm than that of conventional agriculture. The researchers constructed a body of research which argued that: 1) these concepts did in fact represent two greater paradigms; 2) that the emerging paradigm (alternative agriculture) did reflect a greater worldview among the population; and 3) that there is a fundamental difference between these two paradigms (Beus & Dunlap, 1991; Beus & Dunlap,1994a).

Within both the agricultural and psychological literature, division exists concerning whether worldview impacts behavior. Gamon, Harrold, and Creswell (1994) found no significant differences in agricultural practices among farmers based on their agricultural paradigms; Salamon, Farnsworth, Bullock, and Yusuf (1997) found slight differences. However, many suggest that attitudes, beliefs, and perceptions do in fact relate to behavior and those behaviors can be predicted by constructs such as their environmental attitudes (Hawcroft & Milfont, 2009). Beus and Dunlap (1994b) suggested that there is a relationship between agricultural paradigm and behavior. For example, among Washington State farmers, their paradigm influenced their production practices. Comer, Ekanem, Muhammad, Singh, and Tegegne (1999) found that those who self-label as sustainable agriculturalists utilize twice as many sustainable production practices, a significant difference from the conventional agriculturalists (Comer et al., 1999).

Udoto and Flowers (2001) argued that agricultural educators teaching SA must value it to effectively transform student behavior and convey new knowledge. However, minimal research has been conducted on school based agriculture educators' (SBAE) perceptions, beliefs, or attitudes of SA and SAP and how they relate to the instruction of both. The limited research available indicates that secondary agricultural educators have neutral (Agbaje et al., 2001) to somewhat positive perceptions of SA (Muma et al., 2010; Williams & Wise, 1997). Okeafor (2002) did find that SBAE educators perceive that SA inclusion in classroom instruction "would add balance to the curriculum (p. 83)."

Also, largely absent from the existing literature is a current and quality inventory of SBAE educators' self-reported needs regarding their instruction of SA and SAP. The existing research on educator knowledge of SA is somewhat dated, but indicates that both teachers' and their students perceive that they have limited knowledge of SAP (Williams, 2000; Williams & Wise, 1997). In a more recent study aimed at determining teachers' knowledge of SAP, teachers self-reported feeling moderately knowledgeable of the SAP (Udoto & Flowers, 2001). Research also indicates that educators appear to teach SAP to only a moderate extent in their classrooms (Agbaje et al., 2001; Muma et al., 2010; Okeafor, 2002).

The Borich Needs Assessment Model (Borich, 1980) is an accessible, adaptable methodological model drawn from education literature that can be used to identify educator instructional needs. According to Borich, "a training need can be defined as a discrepancy between an educational goal and trainee performance in relation to this goal," (Borich, 1980, p. 3). This model assumes that subjects can evaluate these two objectively (Borich, 1980). Using the Borich Needs Assessment Model can help determine educator need by identifying SBAE educators' competency of SAP and their perceived importance of them.

Statement of the Problem

Michigan is a recognized leader in regional food systems thinking and has demonstrated the economic vitality of its agricultural and natural resources sectors. Nationally and internationally, agriculture is changing and Michigan has the potential to be powerful party to both. Changes in the form of funding and new standards are currently taking place at the national, state, and industry level, which mean that students are increasingly expected to have knowledge of SA and SAP. In addition, Land-grant universities are increasingly considering incorporating SA curriculum into their undergraduate agricultural programming. SBAE educators have the significant task of educating a workforce to have the skill sets, knowledge, values, and experiences that are being required of the modern agricultural student.

However, minimal research exists on instruction of SAP in the classroom and very little of it pertains to Michigan SBAE. SBAE educators from the North Central Region (which includes Michigan) appear to teach SAP to a "moderate" extent in their classrooms (Agbaje et al., 2001; Muma et al., 2010). The lack of a coherent picture of SAP instruction in SBAE is startling given the significant pressure that secondary agricultural educators currently face from the federal government to the agricultural sector to incorporate this into their instruction.

Also lacking is research on whether educator attitudes, beliefs, and perceptions impact their instructional practices of SAP. If perceptions of SA are related to behavior, such as instruction, this will require serious examination (Hawcroft & Milfont, 2009). Currently, studies have indicated that educators tend to have neutral (Agbaje et al., 2001) to somewhat positive perceptions of SA in general (Muma et al., 2010). If moderate perceptions of SA and SAP do relate to the limited instruction, there is a need for in-service training to offer support to better prepare SBAE educators.

Purpose of the Study

The purpose of this study is threefold: 1) determine the demographic composition of Michigan SBAE educators; 2) establish a baseline of attitudes, beliefs, perceptions, and knowledge of SA among Michigan SBAE educators; and 3) determine and prioritize educator in-service needs regarding their instruction of SAP. Attitudes, beliefs, and knowledge of SA among educators will be obtained using existing scales within the literature: the New Ecological Paradigm, the Alternative-Conventional Agricultural Paradigm, and the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive exam. Perceptions will be obtained by having educators define SA in their own words. The Borich Needs Assessment Model (Borich, 1980) will be used to determine educator needs regarding their SAP knowledge and current instruction. Educators will self-identify their knowledge of SAP among a list of practices and the importance of each in their classroom instruction. By obtaining a baseline of these constructs and identifying educator instructional needs of SAP, this study can inform in-service opportunities to support Michigan's SBAE educators. With further validation, these findings can shape SA and SAP curriculum development for Michigan SBAE.

Research Questions

1. What is the demographic composition of Michigan school based agriculture, food, and natural resource educators?
2. What are the attitudes, beliefs, perceptions, and knowledge of SA among Michigan school based agriculture, food, and natural resource educators?
   a. What is the ecological paradigm of SBAE educators as measured by the New Ecological Paradigm (NEP)?
   b. What is the agricultural paradigm of SBAE educators as measured by the Alternative-Conventional Agricultural Paradigm (ACAP)?
   c. What knowledge do SBAE educators possess of SA as measured by the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test?
   d. How do SBAE educators self-define SA?
   e. To what extent do relationships exist between SBAE educators' scores on the following:
      i. The NEP and the ACAP
      ii. The NEP and the cognitive test
      iii. The ACAP and the cognitive test
   f. To what extent do relationships exist between SBAE educators' demographics and NEP score:
      i. Age
      ii. Gender
      iii. Primary Teaching Setting
      iv. Region

v. Years teaching SBAE

vi. Highest Education Completed

3. What are Michigan school based agriculture, food, and natural resource educators' in-service needs regarding their instruction of SAP and what are their priorities?
   a. What are SBAE educators' in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model?
   b. What are the priorities of SBAE educator in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model?

Limitations

The study is limited by its population frame, which targeted only Michigan SBAE ANFR educators. Therefore, the results cannot be generalized to SBAE educators nationwide or to non-school based agriculture, food and natural resource instructors. The descriptive and correlational nature of the results prevents causation from being drawn among the variables. A final limitation is that the scope of the needs assessment involved only a subset of SAP commonly cited in the literature.

Definition of Terms

Career and Technical Education (CTE).A national program that provides "Organized educational activities that:

1. Offer a sequence of courses that
   a. Provides individuals with coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in current or emerging professions;

   b. Provides technical skill proficiency, an industry-recognized credential, a certificate, or an associate degree; and
   c. May include prerequisite courses (other than a remedial course) that meet the requirements of this subparagraph; and
2. Include competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of an industry, including entrepreneurship, of an individual (Carl D. Perkins Career and Technical Education Improvement Act, 2006, p.4)."

In-service. Educational programs for employed school based educators.

Environmental attitude. "A psychological tendency that is expressed by evaluating perceptions of or beliefs regarding the natural environment, including factors affecting its quality, with some degree of favor or disfavor (Milfont, 2007, p. 12).

Paradigm. A "prominent worldview, model or frame of reference through which individuals, or collectively, a society interpret the meaning of the external world (Pirages & Ehrlich, 1974, p. 43).

School based agricultural education (SBAE). The National Council for Agricultural Education at https://www.ffa.org/thecouncil/Pages/aboutus.html defines SBAE as "the formal agricultural education instructional programs offered in grades seven through adult."

Sustainable agriculture. The 1990 Farm Bill defines it as:

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 agriculture economy depends; make the most efficient use of non-renewable resources and integrate where appropriate, natural biological cycles and control; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole. (U.S. Congress, 1990, Code Title 7, Section 3103, n.p.)

Sustainable agricultural practice (SAP). Sustainable agriculture "can take a range of meanings and agricultural practices, depending on the goal, location, means, and time scale, among others that fits an individual (Muma et al., 2010, p. 442)."

Training need. "A discrepancy between an educational goal and trainee performance in relation to this goal, (Borich, 1980, p. 3)."

CHAPTER II

Review of Literature

Udoto and Flowers (2001) argued that it is necessary for SBAE educators who teach SA to value it to effectively transform student behavior and convey new knowledge. Even the 1990 Farm Bill stated that Extension agents must be trained in SA to "develop their understanding, competence, and ability to teach and communicate the concepts" to farmers and others (Agunda, 1995, p. 172). Very few studies have measured the student impact from educators' attitudes toward or knowledge of SA (Muma et al., 2010; Udoto & Flowers, 2001). The chapter presented the body of literature concerning SBAE educators' ecological paradigm, agricultural paradigm, conceptual knowledge of SA, definitions of SA, and their instructional needs regarding SAP. The chapter has been organized by the study's progression of research questions into the following sections:

1. New Ecological Paradigm (NEP)
2. Alternative-Conventional Agricultural Paradigm (ACAP)
3. SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test
4. Defining SA
5. Borich Needs Assessment Model

New Ecological Paradigm (NEP)

The New Ecological Paradigm (NEP) has widely been recognized as a reliable measure of environmental attitudes (EA) on the relationship between humans and the environment; it measured the degree that one viewed the world "ecologically" (Dunlap, 2008). EA have been defined as the "psychological tendency[ies] that [were] expressed by evaluating perceptions of or beliefs regarding the natural environment, including factors affecting its quality, with some degree of favor or disfavor (Milfont, 2007, p. 12). The scale has been widely used both nationally and internationally. Dunlap and Van Liere (1978) argued that a separate environmental paradigm had emerged several decades ago that was separate from the existing so-called Dominant Social Paradigm (DSP). They argued that the new paradigm was fundamentally different in how humans thought about their relationship to and their value of the environment (Dunlap & Van Liere, 1978). They recognized three central concepts around which the paradigms were in opposition: limits to growth, balance of nature, and antianthropocentrism (Dunlap & Van Liere, 1978). Dunlap et al. (2000) defined anthropocentrism as "the belief that nature existed primarily for human use and has no inherent value of its own (p. 431)." The 12-item scale they constructed to measure adherence towards DSP or NEP was originally termed the New Environmental Paradigm (Dunlap & Van Liere, 1978).

Numerous scales measure EA, the three most commonly used are the NEP (Dunlap, et al., 2000), the Ecology Scale (Maloney et al., 1975), and the Environmental Concern Scale (Weigel &Weigel, 1978; Milfont &Duckitt, 2010). A significant asset of the NEP was its uniqueness that it measured worldview rather than specific environmental problems or concerns (e.g. towards pollution) unlike many EA scales (Dunlap et al. 2000).

In Dunlap et al. (2000), the researchers rounded out the scale with two additional concepts: "rejection of exemptionalism" and the "possibility of eco-crisis" (Dunlap et al., 2000). Renamed the New Ecological Paradigm, the updated 15-item scale maintained the strong reliability and validity of its predecessors which were the original 12-item scale and a 6-item one (Hawcroft & Milfont, 2009). The revision responded to criticisms which included the removal of gender-discriminating language and the inclusion of an "unsure" category as a midpoint to cut down on item non-response. NEP scores existed on a continuum which ranged from 15 to 75.

Scores on the lower end of the spectrum indicated support of the DSP in which one viewed the human relationship with the environment more anthropocentrically. Scores on the higher end of the spectrum indicated support of the New Ecological Paradigm (NEP) and an eco-centric worldview meaning that conceptions of the relationship between humans and the environment were viewed are more ecological and balanced.

In 2009, Hawcroft and Milfont conducted a meta-analysis of studies using the NEP; their sample consisted of 139 samples, which represented 58, 279 subjects. Continuing criticisms of the NEP included dimensionality issues and the scales ability to predict behavior (Hawcroft & Milfont, 2009). However, Dunlap and Van Liere (1978) articulated the complexity in predicting behavior with the introduction of the scale. Dunlap et al. (2000) recommended the use of the updated 15-point scale for multiple reasons including to minimize dimensionality issues. Hawcroft and Milfont's (2009) meta-analysis also explored how use of the NEP may have impacted results of individual studies. They strongly cautioned of possible inability of the NEP to detect nuances at the scale's poles.

While the NEP has been used with numerous samples, SBAE educators and other agricultural professionals have rarely been studied. Since researchers have used multiple versions of the scale, to simplify comparisons all mean NEP scores from the literature will be reported as a mean composite score between 1 and 5. The only study on agricultural professionals was an international study focused on pre-service which targeted student teachers in Australia, Indonesia, and the Republic of Maldives. Each group of student teachers held eco-centric worldviews and each were significantly different from every other group: 1) Australians (M=3.99); 2) Indonesians (M=3.71); and 3) Maldivians (M=3.44; Watson & Halse, 2005). Even though females made up of 80% of the sample, there were no significant differences in the worldviews between male and female.

Outside of surveying agricultural professionals, there have been studies which researched environmentally oriented behavior. Residents in Boulder were surveyed to determine whether those participated in environmentally focused civic discussions held different ecological worldviews than their neighbors (Hunter & Rinner, 2004). A random sample of residents in Boulder, Colorado reported a mean NEP of 3.81(Hunter & Rinner, 2004). Hunter and Rinner (2004) acknowledged that the actual sample was less diverse than the 2000 city Census data; subjects were more often: middle-age, female, possessing higher education, non-Latino, and homeowners. The results were presented unweighted as weighing them didn't significantly alter them (Hunter & Rinner, 2004). Clark, Kotchen, and Moore (2003) attempted to understand the internal and external factors influencing Edison customers who had voluntarily participated in a green electricity program. Edison customers in Detroit, Michigan who participated in the program reported a mean NEP of 3.78 compared to that of typical Edison customers (M=3.39; Clark, Kotchen, & Moore, 2003).

Alternative-Conventional Agricultural Paradigm (ACAP)

The Alternative-Conventional Agricultural Paradigm (ACAP) measured the degree that one generally viewed agriculture ecologically. Similarly to the NEP, the researchers who constructed the ACAP observed that a fundamentally disparate paradigm regarding agriculture had emerged from the existing one (Beus& Dunlap, 1990). The scale was created to understand the values and beliefs that differed between them in regards to the controversies that existed around agricultural (Beus & Dunlap, 1990).The existing paradigm, termed conventional agricultural, involved a "capital-intensive, large-scale, highly mechanized agriculture with monocultures of crops and extensive use of artificial fertilizers, herbicides and pesticides, with intensive animal husbandry" (Knorr & Watkins, 1984, p. 37). In contrast, Beus and Dunlap (1990) suggested that alternative agriculture, based on their observations, included a philosophical component and an array of alternative goals such as: 1) as organic practices as possible, 2) reduced chemical inputs, 3) reduced energy use, and 4) greater farm self-sufficiency.

The six defining elements differentiating the agricultural paradigms were 1) centralization versus decentralization, 2) competition versus community, 3) dependence versus independence, 4) domination of nature versus harmony with nature, 5) specialization versus diversity, and 6) exploitation versus restraint (Beus & Dunlap, 1990). The construction of the 24-item ACAP measured favor towards either alternative or conventional paradigm. The scale demonstrated both known-group validity and internal consistency (Beus & Dunlap, 1991).

ACAP scores existed on a continuum which usually ranged from 14 to 70. Scores on the lower end of the spectrum indicated support for the conventional agricultural paradigm, in which one viewed relationships between humans and nature as more anthropocentric. Scores higher on the spectrum indicated support for the alternative agricultural paradigm and value fundamentally different relationships between humans and the environment. Beus and Dunlap (1992) surveyed the following using the ACAP:1) Washington State farmers; 2) faculty of Washington State University's College of Agriculture and Home Economics; 3) known groups of conventional agriculturalists; and 4) known groups of alternative agriculturalists. Since many researchers modify the number of scale items, all the ACAP means were reported as a mean composite score from 1 to 5 with 5 representing the greatest adherence to the alternative agricultural paradigm. Faculty scored statistically significantly more conventional ($M= 3.22$) than the farmers ($M=3.38$) at the 0.001 level (Beus & Dunlap, 1992). Alternative agriculturalists adhered to the alternative paradigm (M=4.25) more than the conventional agriculturalists by a statistically significantly difference (M=3.05); both groups scored significantly different from the faculty at the 0.001 level (Beus & Dunlap, 1992).

Similarly to the NEP, critiques of the ACAP included concerns of gender bias, the bipolar structure of the scale, its unidimensionality, and its ability to predict behavior. Chiappe and Flora's (1998) small study with farmwomen associated with SA organizations demonstrated that the paradigm might need to be further nuanced. They contended that the ACAP may be neglecting two additional and important ways women conceive of sustainable agriculture 1) "quality family life through balanced production," and 2) spirituality (Chiappe & Flora, 1998, p. 391). Jackson-Smith and Buttel (2003) argued that the scale's structure of a forced-choice between the two paradigms is a limitation that resulted in high levels of item non-response among Wisconsin dairy farmers. The researchers questioned the scale's unidimensionality and whether the scale can effectively predict behavior as they argue that an attitudinal scale should (Jackson-Smith, 2003).

Very few studies have used the ACAP with agricultural educators. Muma et al. (2010) surveyed SBAE educators using a modified ACAP to measure their beliefs about SA. After language alterations, the removal of the bipolar item-statements, and the removal of 4-items, the modified scale had a Cronbach's alpha value of more than .82 (Muma et al., 2010). On a scale from one to five with five being strongly agree with the alternative agricultural paradigm, educators indicated that they slightly agreed (M=3.66; SD=.43) with the beliefs statements about SA (Muma et al., 2010). Their beliefs in the social and environmental components of SA were stronger than their beliefs in the economic ones (Muma et al., 2010). Aside from a low-response rate of 30% for which response error was accounted for, the study is fairly strong and provided suggestions for future research (Muma et al., 2010).

Researchers often used the ACAP to explore possible relationships between EA and behavior. Allen and Bernhard (1995) helped to legitimize the ACAP by linking Nebraskan producers' paradigm to their use of conventional or alternative production practices. Comer et al. (1999) suggested that those who self-label as sustainable agriculturalists utilized twice as many sustainable production practices, a statistically significant difference from their conventional agriculturalist counterparts. Finally, the scale has been used to explore farmers' policy positions within a larger continuum of alternative and conventional agriculturalists in Washington State (Beus & Dunlap, 1993).

SARE's "Sustainable Agriculture: Principles and Concept Overview" Cognitive Test

Scales measuring knowledge of SA are limited and tended to consist of Likert-scales in which subjects reported their perceived knowledge of specific SAP (Udoto & Flowers, 2001; Williams, 2000; Williams & Wise, 1997). A scale measuring conceptual knowledge of SA has been missing from the literature. The USDA's Sustainable Agriculture Research and Education (SARE) program has offered grants and educational outreach nationwide to promote sustainability in agriculture. The eXtension online campus, which has been part of the Cooperative Extension System (CES) through the USDA, has supported extension agents and agricultural professionals. SARE and extension online collaborated to construct The Sustainable Agriculture: Principles and Concept Overview course. The course included a cognitive exam which measured the fundamentals of SA knowledge, that SA valued the importance of social, economic, and ecological components. SARE has operated based on the USDA's definition of SA from the 1990 Food Bill:

> 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 agriculture economy depends; make the most efficient use of non-renewable resources and integrate where appropriate, natural biological cycles and control; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole. (U.S. Congress, 1990, Code Title 7, Section 3103, n.p.)

SARE's cognitive exam has demonstrated high reliability and validity (J. Sexton, personal communication, June 21, 2011). As of 2011, 914 out of over 3,000 students completed the Basic Principles course exam and with a score eligible for certification (J. Sexton, personal communication, January 15, 2013).

Defining SA

The literature has also lacked a common scale to obtain one's definition of SA. Dunlap et al. (1992) attempted to extract definitions of SA from diverse populations while constructing a tool to measure definitions of SA. The study included thoughtful survey design and strong methodology with the creation of the Definition of Sustainable Agricultural Scale; however, the scale has not appeared in other researchers work (Dunlap et al., 1992). Paulson (1995) conducted qualitative research involving interviews with extension agents to obtain their definitions. Common definitions among the Minnesota Extension Agents were: "maintaining farm profits in the long and short run and using environmentally sound or resource-conserving practices (Paulson, 1995, p. 123)." She (1995) also noticed only about 20% of the extension agents specified that SA needed to be "socially acceptable." Extension agents also commonly referred to SA as involving "resource conserving practices (Paulson, 1995, p. 123)."

Borich Needs Assessment Model

The Borich Needs Assessment Model was constructed to inform teacher pre-service and in-service (1980). Borich (1980) argued that the justification for conducting a needs assessment was to obtain clear, usable data that easily directed what action should take place next. As an evaluation tool it has been very easy to use, adaptable and has allowed investigators to determine prior to data collection the type and quality of data that will be obtained (Borich, 1980). Designed to yield formative and summative data, the model has allowed investigators to design additional training as needed or to draw comparisons to other programs (Borich, 1980). A strength of the model has been that it allowed the investigator and the participant to have a similar vocabulary. It allowed for clarity about what was in question and for the respondent to provide results that that the investigator was expecting and could make sense of.

The Borich model has commonly been used in agricultural education research (Duncan & Ricketts, 2008; Garton & Chung 1997; Layfield & Dobbins, 2002; Sorenson et. al., 2010) and extension (Waters & Haskell, 1989). Numerous researchers have cited Barrick et al. (1983) in their justification of selecting the Borich model to conduct a needs assessment (Garton & Chung, 1996; Layfield & Dobbins, 2002; Newman & Johnson, 1994; Sorenson et al., 2010). Barrick Ladewig, and Hedges (1983) tested the Borich model's ability to design an in-service program. The researchers legitimized the model's evaluative ability by the fact that it has obtained both self-reported importance and knowledge ratings (Barrick et al., 1983). The investigators concluded that the model "provided defensible data in identifying important topics in which teachers need further knowledge (Barrick et al., 1983, p. 19)."

Although commonly used to assess the in-service needs of beginning instructors (Garton & Chung, 1996; 1997; Joerger, 2002), Layton and Dobbins (2002) tested the model's effectiveness at assessing in-service need among experienced secondary educators. The investigators had similarity findings to Garton and Chung (1996) and demonstrated the effectiveness of the model and advocated for further use with that population (Layton & Dobbins, 2002). Sorenson, Tarpley, and Warnick (2010) conducted a needs assessment among secondary agricultural educators in Utah. The investigators drew from the Utah Applied Technology Skill Certificate Program and existing literature in their selection of competencies; they determined that the model was "an appropriate tool for assessing in-service needs of educators" (Sorenson et al., 2010, p. 9)." The competency rated highest in need of in-service regarded the ability to draw from the surrounding community in establishing opportunities for students (Sorenson et al., 2010). The overall evaluation by Sorenson et al. (2010) revealed similarities with the findings of earlier studies and the researchers called for additional research to determine the level of consistency among other states and nationwide (Garton & Chung, 1997; Joerger, 2002; Layfield & Dobbins, 2002). Duncan and Ricketts (2008) used the model to compare both traditionally and alternatively certified agricultural educators' management of their instruction. Both groups of educators rated their greatest in-service need as technical agricultural content (Duncan & Ricketts, 2008).

Gable, Pecheone, and Gillung's (1981) quadrant analysis model was an additional way of identifying in-service priorities. Using beginning agricultural educators from Missouri, Garton and Chung (1997), used both the Borich model and the quadrant analysis model to identify and prioritize in-service needs. Using a set of competencies established from the literature, Garton and Chung found that regarding the two models, in "identifying in-service needs… [both were] acceptable approaches that yield similar results (1997, p. 58)."

Likert scales have also been used to measure knowledge or competency of SAP such as rotational grazing, row banding of herbicides, filterstrips, and narrow strip intercropping (Udoto & Flowers, 2001; Williams & Wise, 1997). Williams and Wise (1997) examined SBAE educators' and their students' knowledge of SAP. Williams (2000) examined students' knowledge of SAP. Both studies used the same four point Likert-scale from one to four, with 2.50 as the midpoint and four being "I know a Lot." Williams and Wise (1997) reported teachers "know some" about SAP (composite teacher mean=2.87; SD=.74). Both student subject groups reported overall "knowing a little" about SAP and Williams and Wise (1997) reported a composite student mean of 2.16 (SD =0.89). Williams (2000) did not calculate a composite mean, but only three SAP means were rated higher than the midpoint (of 2.50): no-till, rotational grazing, and livestock manure management.

Boone Jr., Hersman, Boone, and Gartin (2007) surveyed Midwestern extension agents about their SA training. On a scale of one to six, with one being strongly disagree and six being strongly agree, agents reported an overwhelming need for SA training, indicating "economics of sustainable agriculture" (M=4.75; SD=.96) and "innovative farming systems" (M=4.64; SD=.96) as their greatest needs (Boone Jr. et al., 2007).

Selection of SAP competencies. Researchers have drawn from the existing literature in selecting and constructing the competencies they included in their needs assessment (Garton & Chung, 1996; Layfield & Dobbins, 2002; Sorenson et al., 2010). There has not been any use of the Borich model to determine SAP instructional need. Further, the literature has lacked a cohesive and exhaustive list of SAP. SA has a "range of meanings and agricultural practices, depending on the goal, location, means, and time scale, among others, that fits an individual (Muma et al., 2010, p. 442)." Cover Cropping, Crop Rotation, Integrated Pest Management,

Management Intensive Grazing, and Reduced Tillage are frequently identified as SAP (Alonge & Martin, 1995; Comer et al., 1999; Muma et al., 2010; Udoto & Flowers, 2001; Williams; 2000; Williams & Wise, 1997). Chapter three has further details regarding the selection of the competencies for the present study.

Summary

The NEP, ACAP, and the SARE were existing scales which measured ecological paradigm, agricultural paradigm, and conceptual knowledge of SA respectively. No studies have measured NEP or knowledge of SA or collected personal definitions of SA among SBAE educators. The single study which measured agricultural paradigm using ACAP among SBAE educators indicated that they had moderately alternative agricultural beliefs, with particular emphasis on environmental and social beliefs (Muma et al., 2010). Researchers have validated the evaluative properties of the Borich Needs Assessment Model. The model has been highly effective at allowing novice and experienced agricultural educators to identify and prioritize in-service need. The model has not been used regarding SAP instruction.

CHAPTER III

Methodology

Introduction

The quality of the workforce entering the food, fiber and energy sectors in large part is dependent on the quality of their education in secondary and post-secondary institutions. However, very little research has been conducted on to understand instruction of SAP in Michigan SBAE programs. Little research exists about SBAE educators' perceptions, beliefs, attitudes, and knowledge of SA. In an effort to obtain a better analysis of the Michigan SBAE instruction regarding SA and SAP, the purpose of this study is threefold: 1) determine the demographic composition of Michigan SBAE educators; 2) establish a baseline of attitudes, beliefs, perceptions, and knowledge of SA among Michigan SBAE educators; and 3) determine and prioritize educator in-service needs regarding their instruction of SAP.

The following questions were used to guide this research:

1. What is the demographic composition of Michigan school based agriculture, food, and natural resource educators?
2. What are the attitudes, beliefs, perceptions, and knowledge of SA among Michigan school based agriculture, food, and natural resource educators?
   a. What is the ecological paradigm of SBAE educators as measured by the New Ecological Paradigm (NEP)?
   b. What is the agricultural paradigm of SBAE educators as measured by the Alternative-Conventional Agricultural Paradigm (ACAP)?
   c. What knowledge do SBAE educators possess of SA as measured by the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test?

d. How do SBAE educators self-define SA?

e. To what extent do relationships exist between SBAE educators' scores on the following:

    i. The NEP and the ACAP

    ii. The NEP and the cognitive test

    iii. The ACAP and the cognitive test

f. To what extent do relationships exist between SBAE educators' demographics and their NEP score:

    i. Age

    ii. Gender

    iii. Primary Teaching Setting

    iv. Region

    v. Years teaching SBAE

    vi. Highest Education Completed

3. What are Michigan school based agriculture, food, and natural resource educators' in-service needs regarding their instruction of SAP and what are their priorities?

    a. What are SBAE educators' in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model?

    b. What are the priorities of SBAE educator in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model?

Population and Sample

Research targeted Michigan SBAE educators teaching during the 2011-2012 school year. The population frame was compiled using the 2011-2012 Agriculture, Food, and Natural

Resource Directory obtained from the Michigan FFA Association; the population frame consisted of 104 educators. The entire population was surveyed.

Instrumentation

The survey consisted of the following existing scales: 1) the NEP (Dunlap et al., 2000); 2) the ACAP (Beus & Dunlap, 1991); and 3) the Sustainable Agriculture: Principles and Concept Overview (SARE). A single qualitative scale item solicited participants' definitions of SA. The survey included a needs assessment based on Borich's model to evaluate educator competency of and importance of teaching a selection of SAP (Borich, 1980). The following demographics were collected: 1) age; 2) gender; 3) highest degree completed; 4) years teaching SBAE; 5) primary teaching setting (CTC or high school); and 6) current teaching region.

New Ecological Paradigm (NEP). The NEP has been used to measure environmental attitudes (EA) concerning the relationship between humans and the environment; in essence how "ecologically" one might view the world (Dunlap, 2008). Specifically, the scale measured ecological worldview in terms of: 1) limits to growth; 2) the balance of nature; 3) antianthropocentrism; 4) rejection of exemptionalism; and 5) the possibility of ecocrisis (Dunlap, Van Liere, Mertig, & Jones, 2000). NEP scores existed on a continuum which ranged from a highly anthropocentric worldview to a highly eco-centric one. Dunlap et al. (2000) defined anthropocentrism as "the belief that nature exists primarily for human use and has no inherent value of its own (p. 431);" the most anthropocentric score was at the lower end of the spectrum and indicated support of the Dominant Social Paradigm (DSP). Scores on the higher end of the spectrum indicated support for the New Ecological Paradigm (NEP) in which conceptions of the human relationship with the environment are more eco-centric.

The NEP was selected for the present study for several reasons. It has been the most commonly used EA measure with research conducted among domestic and international populations (Hawcroft & Milfont, 2009). The NEP's focus on general EA has been one of its strengths; it has allowed researchers to understand a population's worldview, whereas other EA scales have tended to be more specific in scope (Hawcroft & Milfont, 2009). Iterations of the scale have repeated demonstrated strong construct and content validity (Dunlap et al., 2000; Hawcroft & Milfont, 2009). The present study used the full 15-item scale which had addressed earlier critiques of gender discriminating language, balanced scale items, and an established internal reliability with a Cronbach alpha of 0.83 (Dunlap et al., 2000).

Alternative Conventional Agricultural Paradigm (ACAP). The original ACAP scale measured attitudes specifically about agriculture; in essence how ecologically one viewed agriculture. Two agricultural worldviews exist at either ends on a spectrum and have been differentiated by six elements: 1) centralization versus decentralization, 2) competition versus community, 3) dependence versus independence, 4) domination of nature versus harmony with nature, 5) specialization versus diversity, and 6) exploitation versus restraint (Beus & Dunlap, 1990). Scores on the lower end of the spectrum indicated support for the Conventional Agricultural Paradigm, in which relationships between humans and nature were viewed as more anthropocentric. Scores higher on the spectrum indicated support for the Alternative Agricultural Paradigm and valued agricultural systems in which the relationships between humans and the environment are more balanced.

The ACAP was selected for the present study for several reasons. Beus & Dunlap (1991) constructed the ACAP and established a body of research suggesting that there exist two separate and fundamentally disparate worldviews of agriculture among the general population (1991, 1994a). Muma et al. (2010) modified the scale to measure beliefs, rather than EA; their 20-point scale's reliability ranged between .82 and .95. There have been very few studies that specifically measured the psychological construct of beliefs about SA and those that do tend to conflate the construct with other constructs – usually perceptions or attitudes toward SA. For the present study, agricultural paradigm was measured using the modified ACAP from Muma et al. (2010) and the construct it measures will be labeled as beliefs as Muma et al. did as well.

Sustainable agriculture: principles and concept overview. For the present study, respondents' knowledge of SA fundamentals was measured using a cognitive test created by SARE of the USDA. The SARE's Sustainable Agriculture: Principles and Concept Overview was available on the eXtension online campus, which was part of the Cooperative Extension System through the USDA and intended to support extension agents and other agricultural staff. The cognitive test was selected as a measure of SA knowledge because SARE's conceptualization of SA has shaped their outreach and grant funding programs in working with agricultural professionals and extension. Also, the test has demonstrated high reliability (J. Sexton, personal communication, June 21, 2011). Ten true/false questions were selected from the test's complete bank of 48 questions which addressed the fundamental importance of the economic, social, and environmental components of SA.

Reliability and validity. The reliability, face validity, and content validity of the three scales were established through a piloting by experts within Michigan State University's Department of Community, Agriculture, Recreation, and Resource Studies. Internal reliability was determined using Cronbach alpha for the NEP (.719) and the ACAP (.817). Kuder Richardson 20 (K-R20) was used to determine the internal reliability of the cognitive test (SARE). The single false statement was removed which increased the scale's internal reliability considerably (K-R20 = .702). Bivariate Correlations using Pearson were used to obtain test-retest reliability for the ACAP; concerns about internal consistency resulted in the removal of 6 subscale items.

The survey initially consisted of additional scales, one of which was modified during piloting to raise its internal reliability. Ultimately, the Perceptions of Outcomes of SA scale and the Barriers to Teaching scale were eliminated to address lengthy pilot survey times.

Borich Needs Assessment Model. The present study conducted a needs assessment using the Borich model to target competency of certain SAP and the importance they had in instruction. Borich provided a flexible model to ascertain training need which could be incorporated into preservice and in-service programming. Borich argued that training needs could be determined by examining “what is” in comparison to “what should be” (1980). One justification for use of the model in the present study was that it allowed participants to evaluate themselves. Use of this model required the assumption that respondents can objectively evaluate their knowledge of certain competencies and their instruction of it. Twelve agricultural practices, which were labeled competencies, were selected for the study. Respondents were asked to rate the importance the competency in their classroom instruction and how knowledgeable they were of that competency.

Selection of competencies. It was not the researchers’ role to adequately and responsibly indicate which SAP were the most significant for Michigan SBAE educators to demonstrate mastery over. The researcher dictated the parameters of the needs assessment by choosing 12 agricultural practices that have been heavily discussed in the respective literature.

Ten SAP were selected from the literature (see Table 1). Cover Cropping, Crop Rotation, Integrated Pest Management, Management Intensive Grazing, and Reduced Tillage were selected

Table 1
Literature Supporting Competency Selection

Competencies	
SAP	Conventional Practices
Composting [b]	Genetically Engineered Crops [e]
Cover Cropping [a, b, c, f]	Pest Resistant Crops [e]
Crop Rotation [a, b, c, d]	
Integrated Pest Management [b, c, d, e, f]	
Management Intensive Grazing [b, c, e, f]	
Mixed Farming [c, e, f]	
Nitrogen Cycle [a, d]	
Reduced Tillage [c, d, e]	
Soil Conservation [d, e]	
Water Quality [c, d, e]	

Note. [a] = Alonge & Martin (1995); [b] = Comer et al. (1999); [c] = Muma et al. (2010); [d]= Udoto & Flowers (2001); [e] = Williams (2000); [f] = Williams & Wise (1997).

based on literature's frequent identification as SAP (Alonge & Martin, 1995; Comer et al., 1999; Muma et al., 2010; Udoto & Flowers, 2001; Williams; 2000; Williams & Wise, 1997). A Mixed Farming competency was created to include those practices in which animals and crops were considered in the same system; it was an umbrella for practices from the literature such as "use of animal manure" or "livestock manure management" (Muma et al, 2000; Williams, 2000) recycling agricultural wastes, use of green manure" and "use of low input livestock facilities" (Muma et al., 2010; Williams 2000; Williams & Wise, 1997). Similarly, a Nitrogen Cycle competency was created to incorporate practices such as "crop rotations that increase soil nitrogen and reduce the need for purchased fertilizers" (Udoto & Flowers, 2001), "reduced nitrogen fertilizer rates, soil nitrogen testing, spring and summer nitrogen application" (Alonge & Martin, 1995), and "reduced nitrogen fertilizer rates" (Muma et al., 2010). A Compost competency was created based on its current popularity.

Two agricultural practices typically associated with conventional agriculture were included: Genetically Engineered Crops and Pest Resistant Crops. The inclusion allowed the researcher to compare the SAP and conventional agricultural practices in terms of: 1) educator knowledge; 2) importance of these competencies to their instruction; and 3) how educators' prioritize their needs. Including that comparison provided a more comprehensive picture of Michigan SBAE educator need for curriculum developers and in-service programming.

Research Design

The survey methodology: 1) obtained demographic information; 2) measured Michigan SBAE educators' agricultural paradigm, ecological paradigm, and their knowledge of SA; 3) obtained educators' definition of SA; and 4) determined and prioritized needs of educators' classroom SAP instruction. A census of the population frame was invited to participate in the survey. The online software Qualtrics was used to construct the survey and collect and store the data. Instrument construction and correspondence with subjects followed Dillman's Tailored Design Method to maximize response rates (Dillman, Smyth, & Christian, 2009). All educators were informed that survey participants would be entered into a randomized raffle to receive one of three Amazon gift cards of $50 each. Interested participants were instructed of their rights and their role as a research participant prior to beginning the survey (Appendix A).

Data Collection

The week of March 19, 2012, Michigan State University Professor and Agricultural Educator Dr. Matt R. Raven notified a census of the population frame of the research study via mass email. Educators were informed of the study, told that they would receive an invitation via email, and invited to participate. Dillman et al. (2009) argued that type of initial contact improved response rates. All remaining electronic correspondence was personalized to maximize response rates (Dillman et al., 2009). On March 27, 2012, the researcher emailed the same census information regarding the research and an invitation to participate in a survey via a web link (Appendix C). Dillman et al. (2009) argued that reminders heighten response rates; those individuals with incomplete surveys were sent up to three reminders following the initial invitation (Appendix D). The first reminder was emailed on April 9, 2012 from Dr. Randy Showerman of Michigan Department of Education. The researcher emailed all the remaining correspondence with the educators which included a second reminder sent April 25, 2012; a third reminder sent May 10, 2012; and a thank you sent July 22, 2012 (Appendix E). A total of 47 completed surveys and 3 incomplete surveys were collected for a response rating of 45%.

Non-response error was addressed by contacting a small subset of non-respondents from the population frame to obtain data for a select number of scale items (Bethlehem, Cobben, & Schouten, 2011). A combination of the call back approach (Hansen & Hurwitz, 1946) and basic question approach was used (Bethlehem et al., 2011). They were asked to provide responses to the NEP and ACAP to determine whether non-respondents exhibited any significant differences in their agricultural and ecological worldview from survey respondents. The researcher acknowledged the likelihood of error which could have resulted by doing the shortened survey with the non-respondents over the phone rather than online like the survey respondents did.

Thirty non-respondents were initially selected at random and contacted by the researcher via phone at their place of employment (Appendix H). These individuals were reminded about the survey and its significance and invited to participate in a shortened survey over the phone. If the individual was not available, messages were left on voice mail or with an individual (e.g. staff). Fourteen non-respondents participated between June 6, 2012 to June 8, 2012. Three additional participants demonstrated interest in the survey after non-response data collection had been finished. A thank-you and contact information was emailed to the 14 non-respondents on November 9, 2012 (Appendix I).

Non-response error was addressed in two ways. First, independent t-tests compared the summed NEP and ACAP means of survey respondents ($n = 50$) to those contacted by phone ($n = 14$) to determine whether there were any differences in worldviews of non-respondents. No significant differences existed between groups regarding their worldviews (ACAP $p= 0.55$; NEP $p= 0.67$).Known demographic traits were also compared between non-respondents and survey respondents as a way to determine the homogeny between the two. A Pearson Chi-square was selected to determine whether the responses was the result of chance in terms of demographics. Females were more likely to respond to the survey than males (Chi-square=4.81; $p=0.03$) and educators who taught primarily in CTC settings were more likely to respond than their high school counterparts (Chi-square=4.90; $p=0.03$). Teaching region was not associated with higher response rates (Chi-square=1.48; $p=0.92$). Despite the study's low response rate, the homogeny in worldviews between respondents' and non-respondents' NEP and ACAP scores meant the respondents' agricultural and ecological paradigms reflected those of the Michigan SBAE educators. Data collection among teaching regions was representative of Michigan SBAE educators, however, not in terms of gender and primary teaching setting. The results could not be generalized to that population and conclusions of the study took that into consideration.

Data Analysis

The study was an exploratory descriptive/correlational research study. Using Statistical Packaging for Social Sciences (SPSS) version 19.0, quantitative data analysis obtained: descriptive statistics, frequencies, crosstabs, and correlations. Where descriptive statistics were used, the mean, standard deviation, minimum and maximum scores were reported. Frequencies were reported using valid percentages unless specified. Where correlations were reported, effect size was estimated as follows: 1) a strong correlation for Pearson (r) values between ± 0.50 and ± 1.00; 2) a moderate correlation for (r) values between ± 0.30 and ± 0.50; and 3) a weak correlation for (r) values between 0 and ± 0.30 (Cohen, 1992). The qualitative data were analyzed with NVivo version 9.0 using thematic coding.

Analysis of first research question. The first research question determined who Michigan SBAE educators were in terms of their demographic traits. Analyses of educator demographics were as follows: 1) descriptive statistics determined age; and 2) frequencies determined gender, primary teaching setting, region, years teaching SBAE, and highest degree completed.

Analysis of second research question. The second research question determined who Michigan's SBAE educators' were in terms of their ecological paradigm, agricultural paradigm, knowledge of and definitions of SA. Descriptive statistics were obtained for summed NEP and ACAP scores. Frequency distributions were generated for ACAP scale items. Descriptive statistics were produced for summed SARE scores and frequencies were calculated for each scale item.

The NEP and the ACAP measured quantitative, ordinal data on a five-point Likert scale which measured agreement. A response of Strongly Disagree was assigned a one, a response of Disagree was assigned a two, a response of Neutral was assigned a three, a response of 4 was assigned Agree, and a response of Strongly Agree was assigned a 5. Agreement with the seven even NEP scale items favored the Dominant Social Paradigm; scores for these seven scale items were reversed. NEP responses were summated. Scores could range from 15 to 75 with higher scores reflecting deeper adherence to the New Ecological Paradigm. One mostly incomplete NEP response was dropped.

Agreements with two ACAP scale items favor the Conventional Agricultural Paradigm: 1) Innovations in agricultural technology determine the success of SA; and 2) SA promotes specialized crop and livestock enterprises. Scores for these two scale items were reversed. ACAP responses were summated. Scores could range from 14 to 70 with higher scores reflecting deeper adherence to the Alternative Agricultural Paradigm. For responses with missing data, a mean of the existing values was obtained for the number of responses completed.

The cognitive test (SARE) provided 4 possible responses to each SA statement and obtained a correct response (value of 1) or incorrect response (value of 0). The responses were summated with a possible range of scores from 0 to 9. A reliability analysis among survey respondents revealed a K-R20 of .625. As a cognitive test with a set of correct responses, missing data was treated as incorrect (value of 0).

One scale item, the respondents' definitions of SA, was analyzed qualitatively. Qualitative analysis has been conceptualized as the process of recognizing concepts or themes, clarifying their meaning, creating codes for the themes, reorganizing themes, and refining them (Rubin & Rubin, 2005). Qualitative analysis was selected to provide an insider or "emic" account of the Michigan SBAE educators understanding of SA. Obtaining an insider account allowed for a comparison between SBAE educators' own conceptions of SA and the concepts drawn from the literature such as the cognitive test. Thematic coding was selected to provide an interpretative analysis of the respondents' definitions of SA, which would determine some initial themes on a topic not widely researched. The data were analyzed in NVivo 9 and codes were identified inductively. After reading the data initially for codes, the codes were defined and refined. Data was reviewed twice more to further refine codes. Finally, all the data under each code were reviewed and summaries were written for each.

Pearson's Correlational Coefficient tested the possibility of relationships between educator worldviews and their knowledge of SA: 1) NEP and ACAP; 2) NEP and SARE; and 3) ACAP and SARE. Pearson's Chi-square tested the independence of an association between ecological paradigm and nominal data demographics. Pearson's Chi-square tested the association between NEP score and gender, region, and primary teaching setting. Cramer's V measured the magnitude of possible associations. Pearson's tested the relationship between NEP with age and years teaching SBAE. Kendall's Tau tested the relationship between NEP and highest level of education.

Analysis of third research question. The third research question sought to identify and prioritize the in-service needs regarding SAP instruction among educators. Using the Borich Model, Knowledge and Importance were measured using four-point, ordinal Likert scales. Importance ranged from Very Unimportant to Very Important with Very Unimportant being assigned a value of 1, Unimportant being assigned a value of 2 and so on. Knowledge ranged from Very Knowledgeable to Very Unknowledgeable with Very Unknowledgeable being assigned a value of 1, Unknowledgeable being assigned a value of 2 and so on.

Four values were obtained in the process to determine educator "need" (Borich, 1980). For each competency, the following were obtained: 1) Individual Discrepancy Scores; 2) a Mean Importance Rating; 3) Individual Weighted Discrepancy Scores; and 4) a Mean Weighted Discrepancy Score. Discrepancy Scores were calculated for each participant, for each competency. Each discrepancy score was obtained by subtracting an individual's reported Knowledge of a competency from their reported Importance of the competency. A mean of the

Importance ratings of each competency was calculated. An Individual Weighted Discrepancy Score was obtained by multiplying the Individual Discrepancy Score by that competency's Mean Importance Rating. A Mean Weighted Discrepancy Score was calculated for each competency by dividing the summed Weighted Discrepancy Scores by number of respondents. The competencies were ranked according by their Mean Weighted Discrepancy Score. Mean Weighted Discrepancy Scores are directly proportional to the educator need.

CHAPTER IV

Data Analysis

Introduction

The data presented in the present chapter were collected from a survey determining Michigan SBAE educators' ecological paradigm, agricultural paradigm, definition of and knowledge of SA. Additionally, a needs assessment was conducted among the educators to determine need of SAP instructional support. The following research questions guided the analysis of the data and reporting of results:

1. What is the demographic composition of Michigan SBAE educators?
2. What are the attitudes, beliefs, perceptions, and knowledge of SA among Michigan SBAE educators?
    a. What is the ecological paradigm of SBAE educators as measured by the New Ecological Paradigm (NEP)?
    b. What is the agricultural paradigm of SBAE educators as measured by the Alternative-Conventional Agricultural Paradigm (ACAP)?
    c. What knowledge do SBAE educators possess of SA as measured by the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test?
    d. How do SBAE educators self-define SA?
    e. To what extent do relationships exist between SBAE educators' scores on the following:
        i. The NEP and the ACAP
        ii. The NEP and the cognitive test
        iii. The ACAP and the cognitive test

f. To what extent do relationships exist between SBAE educators' demographics and NEP score?

3. What are Michigan SBAE educators' in-service needs regarding their instruction of SAP and what are their priorities?
   a. What are SBAE educators' in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model?
   b. What are the priorities of SBAE educator in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model?

Findings for RQ 1: What is the demographic composition of SBAE educators?

Descriptive statistics were calculated for age. Frequencies were calculated for: 1) age; 2) gender; 3) primary teaching setting; 4) teaching region; 5) highest level of education; and 6) years teaching SBAE. Respondents (n=47) ages ranged from 25 to 61 and the mean age was 38.9 years (SD=10.43). Further description of respondents' age was provided in Table 2 along with frequency counts of all the demographic data collected.

Nearly half (44%) of respondents were between ages 31 and 40 and almost a quarter of the respondents (24%) were between ages 25 and 30. Those between ages of 41 and 50 were the least represented (11%). Females (n=28) made up over 60% of the response rate, with males (n=18) consisting of less than 40 percent as indicated in Table 2. Two-thirds of the respondents (67%) reported that their primary teaching setting was a comprehensive four-year high school (n=30); the remaining one-third (33%) taught at a career tech center (CTC). Each of the six teaching regions was almost equally represented; region 5 was an exception, 21% of all respondents were from this region (n=10). In terms of years teaching SBAE, respondents

Table 2
Frequencies and Percentages of SBAE Educators by Demographic

Demographic		n	%
Age		46	
	25-30	11	23.9
	31-40	20	43.5
	41-50	5	10.9
	51-61	10	21.7
Years Teaching SBAE		46	
	0-5	11	23.9
	6-10	10	21.7
	11-15	12	26.1
	16-20	3	6.5
	21-25	3	6.5
	26 or more	7	15.2
Gender		46	
	Female	28	60.9
	Male	18	39.1
Primary Teaching Setting		45	
	Four-Year High School	30	66.7
	Career Tech Center	15	33.3
Teaching Region		45	
	1	8	17.8
	2	7	15.6
	3	7	15.6
	4	6	13.3
	5	10	22.2
	6	7	15.6
Highest Level of Education		46	
	Bachelors	12	25.5
	Masters	32	68.1
	Doctorate	1	2.1
	Other	1	2.1

reported: 1) 11-15 years of experience (26%); 2) 0-5 years (24%); and 3) 6-10 years (22%). According to Table 3, over two-thirds of respondents (68%) completed a Masters degree and one respondent completed a doctorate degree (2%). One respondent selected the Other option and wrote in the response completion of a "Bachelors + 30."

Findings for RQ 2: What are SBAE educators attitudes, beliefs, perceptions, and knowledge of SA?

RQ 2a: Educators' ecological paradigm as measured by the NEP. The NEP was established as a measure of environmental attitudes (EA) in terms of the relationship between humans and the environment. In other words, it measured how "ecologically" one generally viewed the world (Dunlap, 2008). The scale measured environmental worldview in terms of: 1) limits to growth; 2) the balance of nature; 3) antianthropocentrism; 4) rejection of exemptionalism; and 5) the possibility of ecocrisis (Dunlap, Van Liere, Mertig, & Jones, 2000).

NEP scores existed on a continuum which ranged from 15 (highly anthropocentric worldview) to 75 (highly eco-centric worldview). Scores on the lower end of the spectrum indicated support of the Dominant Social Paradigm (DSP) in which one viewed the human relationship with the environment more anthropocentrically. Dunlap et al. (2000) defined anthropocentrism as "the belief that nature exists primarily for human use and has no inherent value of its own (p. 431)." Scores on the higher end of the spectrum indicated support for the New Ecological Paradigm (NEP) in which that relationship was viewed as more ecological and balanced. Dunlap and Van Liere (1978) designed the scale so that agreement with even scale items supported an anthropocentric worldview; those scores were reverse coded to obtain the NEP mean. The present study followed the same procedure to obtain the NEP mean. Table 3 indicated that the respondents' (n=47) mean composite score was 49.6 (SD = 8.70), which indicated that SBAE educators generally held a slightly eco-centric worldview. That meant, to a

Table 3
Mean, Standard Deviation, and Range of Scores for Composite NEP Score (n=47)

Ecological Paradigm	Mean	SD	Min	Max
NEP Score	49.6	8.70	22	71

slight degree, educators' EA revolved around an ecological relationship between humans and the environment.

NEP scale item data was presented in Table 4 in terms of means and frequency distributions in accordance with Dunlap and Van Leire's (1978) data presentation. An overall examination of the data and an examination of the data by subscale were included below.

Overall, respondents were not unanimous in the beliefs about the relationship between human and environment. Almost all respondents (96%) agreed with item 9 that "humans were subject to the laws of nature" and two-thirds (66%) agreed that "the balance of nature was very delicate and easily upset." Over 60% disagreed that "the balance of nature was strong enough to cope with the impacts of modern industrial nations." Only two other scale items garnered frequencies higher than half of the sample (53% and 51%), both of which were under the subscale reality of limits to growth. Over and over again, the SBAE educators were not homogeneous in their ecological worldview. The exceptions were that most thought: 1) we as humans were operating within the confines of nature's laws (almost all SBAE educators thought that); 2) that nature's workings could be easily disrupted; and 3) that nature cannot overcome the consequences of our highly industrialized world.

A large frequency of educators didn't respond one way or another regarding their attitudes about the environment; on seven out of fifteen items, approximately a third of responses were neutral. Six additional items had neutral responses 20-25% of the time. The two most common neutral items were "plants and animals have as much right as humans to exist" (34%)

Table 4

Means, Standard Deviations, and Frequency Distributions for NEP Scale Items (n=47)

	Please indicate to what extent you AGREE with the following statements:	M	SD	Responses: Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	We are approaching the limit of the number of people that the earth can support.	3.4	1.23	3 (6%)	10 (21%)	10 (21%)	14 (30%)	10 (21%)
2	Humans have the right to modify the natural environment to suit their needs.	2.9	1.06	3 (6%)	18 (38%)	10 (21%)	14 (30%)	2 (4%)
3	When humans interfere with nature, it often produces disastrous consequences.	3.5	1.02	1 (2%)	7 (15%)	16 (34%)	15 (32%)	8 (17%)
4	Human ingenuity will ensure that we do not make the earth unlivable.	3.3	0.90	0 (0%)	11 (23%)	15 (32%)	18 (38%)	3 (6%)
5	Humans are severely abusing the environment.	3.3	1.22	4 (9%)	8 (17%)	12 (26%)	14 (30%)	9 (19%)
6	The earth has plenty of natural resources if we just learn how to develop them.	3.4	1.07	1 (2%)	11 (23%)	12 (26%)	16 (34%)	7 (15%)
7	Plants and animals have as much right as humans to exist.	3.3	1.11	2 (4%)	9 (19%)	16 (34%)	12 (26%)	8 (17%)
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations.	2.5	1.04	5 (11%)	24 (51%)	8 (17%)	8 (17%)	2 (4%)
9	Despite our special abilities, humans are still subject to the laws of nature.	4.2	0.48	0 (0%)	0 (0%)	2 (4%)	35 (75%)	10 (21%)
10	The so-called "ecological crisis" facing humankind has been greatly exaggerated.	2.9	1.10	4 (9%)	16 (34%)	12 (26%)	12 (26%)	3 (6%)

Note. Full Prompt: Based on your own ATTITUDES, please indicate to what extent you AGREE with the following statements; Agreement with the seven odd items indicate a more ecological worldview; Agreement with eight even items indicate a more anthropocentric worldview; Values: Strongly Agree = 5; Strongly Disagree = 1; M=mean; SD=standard deviation; Percentages may not add up to 100% due to rounding.

Table 4 (cont'd)

	Please indicate to what extent you AGREE with the following statements:	M	SD	Responses				
				Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
11	The earth is like a spaceship with very limited room and resources.	3.5	1.04	1 (2%)	9 (19%)	12 (26%)	18 (38%)	7 (15%)
12	Humans were meant to rule over the rest of nature.	3.0	1.13	6 (13%)	9 (19%)	15 (32%)	14 (30%)	3 (6%)
13	The balance of nature is very delicate and easily upset.	3.7	0.80	1 (2%)	1 (2%)	14 (30%)	25 (53%)	6 (13%)
14	Humans will eventually learn enough about how nature works to be able to control it.	2.6	0.82	2 (4%)	22 (47%)	15 (32%)	8 (17%)	0 (0%)
15	If things continue on their present course, we will soon experience a major ecological catastrophe.	3.3	1.04	2 (4%)	9 (19%)	15 (32%)	16 (34%)	5 (11%)

Note. Full Prompt: Based on your own ATTITUDES, please indicate to what extent you AGREE with the following statements; Agreement with the seven odd items indicate a more ecological worldview; Agreement with eight even items indicate a more anthropocentric worldview; Values: Strongly Agree = 5; Strongly Disagree = 1; M=mean; SD=standard deviation; Percentages may not add up to 100% due to rounding.

and "when humans interfere with nature, it often produces disastrous consequences (34%)." In other words, a third of SBAE educators did not feel compelled one way or another regarding whether plants and animals have a place alongside humans in the world or whether human interference with nature has devastating effects. The high levels of neutrality on the later subscale item seemed disconnected from earlier discussed frequencies. For instance, 60% of respondents did not agree that nature can withstand the impacts of our industrialized world, 66% thought that the balance of nature was delicate, and almost all of them thought that we as humans were operating within the confines of nature's laws. The neutral data could be the result of high indecision among SBAE educators regarding their attitudes toward the environment and humans' relationship within it, perhaps an unwillingness to commit to their attitudes on a survey sourced from a colleague, and/or that the language could have appeared biased on some scale items.

Reality of limits to growth. Dunlap (2008) conceived of this subscale as the existence of "limits to growth beyond which our industrialized society cannot expand (p. 7)." The subscale consisted of items 1, 6, and 11. Half of the respondents thought that there were population and resource limits: 51% agreed with item 1 that "we were approaching the limit of the number of people the earth can support," and 53% agreed with item 11 that the "earth was like a spaceship with limited room and resources." That meant that half of the respondents thought that there were real limits to growth in terms of the human population and natural resources and that we were nearing our population limit. However, equal percentages (49%) of respondents thought that we have "plenty of natural resources if we learn how to develop them (item 6)." In other words, a near majority of respondents believed that human ingenuity was sufficient to prevent an exhaustion of resources, almost as many as those that thought there were limits to the population, natural resources and available space.

A sizeable contingency of respondents consistently disagreed with additional scale items. Frequencies of disagreement and neutrality were similar over each subscale item; the pattern also occurred between items. A quarter (25%) disagreed with and felt neutrally (26%) towards item 6 that we had "plenty of natural resources." A quarter (27%) disagreed with and one-fifth (21%) felt neutrally about item 1 that "we are approaching the limit of the number of people." One-fifth (21%) disagreed with and a quarter (26%) felt neutrally about item 11 that the "earth had limited room and resources." Overall, there were consistently large percentages of respondents who thought that limits did not exist in terms of the human population, available space, or natural resources, and that society was not nearing a human limit. However, a similar contingency of respondents thought that natural resources were limited.

Antianthropocentrism. Dunlap et al. (2000) conceived of antianthropocentrism the rejection of "the belief that nature exists primarily for human use and has no inherent value of its own (p. 431)." The subscale consisted of items 2, 7, and 12. Overall, respondents were highly divided in terms of their attitudes toward antianthropocentrism. While two-fifths of respondents (38%) disagreed with item 2 that "humans have the right to modify the natural environment to suit their needs," a third (30%) agreed. A third agreed with (36%), disagreed with (32%), and felt neutrally toward (32%) item 12 that "humans were meant to rule over the rest of nature." Respondents agreed with item 7 two-thirds of the time (43%) that "plants and animals have as much right to exist as humans." In addition, the same percentage of respondents disagreed (34%) with the item 7 as were neutral (32%) about it. The data indicated that respondents' attitudes were mixed in how they viewed man's place in the environment and the worth of the environment to man. That included division over the EA that man could bend the environment to his will, that man's rightful place was as a ruler over nature, and whether plants and animals were entitled to life. The high percentages of neutral responses suggested that many respondents had difficulty selecting a response that fit their attitudes for the subscale.

Fragility of nature's balance. Dunlap (2008) conceptualized this subscale as the idea that "humans must live in harmony with nature in order to survive (p. 7)." Items 3, 8, and 13 made up the subscale. Overall, a majority of respondents thought that they must operate within nature's laws to survive. Half of them (49%) agreed with item 3 that "when humans interfere with nature, it has produced disastrous consequences." Almost two thirds (62%) disagreed with item 8 that nature can "cope with the impacts of our modern industrialized world." Another two-thirds agreed with item 13 (66%) that the "balance of nature was very delicate and easily upset" and hardly anyone disagreed (4%). The data indicated that respondents thought that nature was fragile and that our modern, industrialized world carried a heavy toll on the balance of nature; the frequencies were among the highest for all the subscales. In addition, half of them thought that severe consequences result when humans disrupt nature. A small contingency of respondents existed who agreed with item 8 (21%) that nature could cope with the effects of our industrialized world and disagreed with item 3 (17%) that humans interference in nature has usually had devastating effects.

A third of respondents rated items 3 (34%) and 13 that the balance of nature was delicate neutrally (30%). In other words, a third of SBAE educators did not feel compelled one way or another whether human interference with nature has incredibly severe consequences. The high levels of neutrality for item 13 about whether nature's balance was easily disrupted seemed disconnected from the strong numbers of respondents who thought the balance of nature was fragile.

Rejection of exemptionalism. Dunlap et al. (2000) conceived of this subscale as a rejection of the idea "that humans—unlike other species—are exempt from the constraints of nature" (p. 432). The subscale consisted of items 4, 9, and 14. Overall, respondents' responses varied widely between subscale items. Almost all respondents (96%) agreed with item 9 that "humans are subject to the laws of nature." Half (51%) disagreed with item 14 that "humans will eventually learn enough about how nature works to be able to control it." Over two-fifths (44%) agreed with item 4 that "human ingenuity will ensure that we do not make the earth unlivable." Overall, the data indicated that respondents held divided and inconsistent attitudes about exemptionalism. Almost universally, respondents thought that humans were limited to the confines of nature. Half of respondents thought that humankind will never be able to exert control over nature but almost half thought that human ingenuity was the key to preserving earth as a viable place to live.

A more detailed examination of the data showed further inconsistencies regarding respondents' attitudes about humans' place within nature. Almost a fifth (17%) of them thought that the ability for humankind to eventually control nature was feasible (Item 4). Less than a quarter (23%) thought that human ingenuity was insufficient (at least in and of itself) to protect the earth from becoming unlivable (Item 14). A third of respondents (32%) held neutral attitudes about both items. The fact that two of the items elicited neutral responses from a third of the sample could have resulted from the items being written in a biased language. Despite holding a near universal attitude that humans were subject to the laws of nature, only a small subset of educators thought that the sustainability of a habitable earth cannot be guaranteed by human ingenuity. Additionally, a small subset of educators thought that humankind has the potential to gain enough knowledge to dominate nature.

Possibility of eco-crisis. Dunlap et al. (2000) conceptualized this subscale as the "likelihood of potentially catastrophic environmental changes or 'ecocrises' besetting humankind" (p. 432). Items 5, 10, and 15 made up the subscale. As displayed in Table 4, respondents agreed with item 5 that "humans are severely abusing the environment" half of the time (50%) and less than half (45%) agreed with item 15 that "we will soon experience a major ecological catastrophe." Over two-fifths (43%) of respondents disagreed with item 10 that the "'ecological crisis' facing humankind has been greatly exaggerated." Overall, the data indicated that a large subset of respondents thought that certain human interactions with the world could be labeled abusive, that our current means of living will lead to an eco-crisis, and that the idea eco-crisis was reasonable and valid.

The data revealed that a smaller but sizable number of educators disagreed. A quarter (26%) of respondents disagreed with the EA that "humans were severely abusing the environment" and that "we will soon experience a major ecological catastrophe (24%)" A third (32%) agreed that the "'ecological crisis' facing humankind has been greatly exaggerated." This smaller subset of educators thought that human impact on the world was not abusive, that we are not threatened by an imminent eco-crisis, and that the eco-crisis concept has been grossly inflated. A third (32%) of responders was neutral regarding the possibility of an eco-crisis, which could be the result of the loaded language the item was written in.

RQ 2b: Educators' agricultural paradigm as measured by the ACAP. The ACAP was used in the present study to measure beliefs around agricultural. The scale measured the degree that respondents generally viewed agriculture ecologically. Two agricultural worldviews were at either ends of the spectrum and were differentiated by six elements: 1) centralization versus decentralization, 2) competition versus community, 3) dependence versus independence,

4) domination of nature versus harmony with nature, 5) specialization versus diversity, and 6) exploitation versus restraint (Beus & Dunlap, 1990). ACAP scores were on a continuum which ranged from 14 (highly conventional agricultural paradigm) to 70 (highly-alternative agricultural paradigm). Scores on the lower end of the spectrum indicated support for the conventional agricultural paradigm, in which relationships between humans and nature were viewed more anthropocentrically. Higher scores on the spectrum indicated support for the alternative agricultural paradigm and valued fundamentally different relationships between humans and the environment, relationships that were ecological. Agreement with scale items 13 and 14 supported a conventional worldview of agriculture and were reverse coded to obtain the ACAP mean. According to Table 5, respondents' (n=48) mean composite ACAP score was 53.1 (SD = 5.24), which suggested that SBAE educators viewed agriculture with a moderately ecological lens. In other words, overall, respondents' beliefs about agriculture were based around an ecological relationship between humans and the environment.

Table 5
Mean, Standard Deviation, and Range of Scores for Composite ACAP Score (n = 48)

Agricultural Paradigm	Mean	SD	Min	Max
ACAP Score	53.1	5.24	34	62

ACAP scale item data was presented in Table 6 in terms of means and frequency distributions; the presentation of item means was in accordance with data presentation from the literature (Jackson-Smith & Buttel, 2003; Muma et al., 2010). Respondents consistently held a moderate alternative agricultural worldview across individual scale items. There was almost universal agreement on five of the 14 scale items and over 70% agreement on five others. Disagreement with scale items occurred less than 5% of time for 11 out of 14 items. Only 2 out

Table 6

Means, Standard Deviations, and Frequency Distributions for ACAP Scale Items (n = 48)

	Please indicate to what extent to you agree with the following belief statements about sustainable agriculture:	M	SD	Responses				
				Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Development of healthy soils is important for SA	4.7	0.45	0 (0%)	0 (0%)	0 (0%)	13 (27%)	35 (73%)
2	SA conserves natural resources for the benefit of future generations	4.7	0.47	0 (0%)	0 (0%)	0 (0%)	15 (31%)	33 (69%)
3	Crop rotation is important to achieving SA	4.4	0.61	0 (0%)	0 (0%)	3 (6%)	24 (50%)	21 (44%)
4	SA promotes recycling of renewable natural resources	4.5	0.55	0 (0%)	0 (0%)	1 (2%)	21 (44%)	26 (54%)
5	Exchange of knowledge about locally designed technologies among producers promotes SAP	4.1	0.80	1 (2%)	0 (0%)	6 (13%)	25 (52%)	16 (33%)
6	Integrating diverse crops with livestock enterprises promotes SA	4.0	0.81	1 (2%)	0 (0%)	10 (21%)	25 (52%)	12 (25%)
7	Local farming practice impacts success of SA	4.4	0.62	0 (0%)	1 (2%)	0 (0%)	24 (50%)	23 (48%)
8	The size of a community impacts development of SA	3.3	1.26	4 (8%)	10 (21%)	11 (23%)	13 (27%)	10 (21%)
9	SA promotes local processing of agricultural production	3.9	0.80	1 (2%)	0 (0%)	13 (27%)	25 (52%)	9 (19%)
10	Local knowledge of farming in a community is an indication of sustainability in agriculture	3.7	0.98	0 (0%)	8 (17%)	10 (21%)	21 (44%)	9 (19%)
11	SA reduces need for external sources of inputs	3.4	1.08	3 (6%)	6 (13%)	16 (33%)	16 (33%)	7 (15%)

Note. [a]Agreement with these statements support a more conventional worldview of agriculture; Values: Strongly Agree=5; Strongly Disagree = 1; M=mean; SD=standard deviation; Percentages may not add up to 100% due to rounding.

Table 6 (cont'd)

	Please indicate to what extent to you agree with the following belief statements about sustainable agriculture:	M	SD	Responses				
				Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
12	SA promotes local marketing of agricultural production	3.7	0.89	1 (2%)	1 (2%)	18 (38%)	18 (38%)	10 (21%)
13	SA promotes specialized crop and livestock enterprises[a]	3.8	0.69	0 (0%)	2 (4%)	12 (25%)	29 (60%)	5 (10%)
14	Innovations in agricultural technology determine the success of SA[a]	3.9	0.92	0 (0%)	4 (8%)	10 (21%)	20 (42%)	14 (29%)

Note. [a]Agreement with these statements support a more conventional worldview of agriculture; Values: Strongly Agree=5; Strongly Disagree = 1; M=mean; SD=standard deviation; Percentages may not add up to 100% due to rounding.

of 14 scale items received less than a majority of agreement and frequencies of agreement were still almost half of the sample (48%).

Among the 5 scales that received almost universal agreement, all respondents agreed that the “development of healthy soils is important” for SA and that it “conserves natural resources for the benefit of future generations.” Ninety-eight percent of respondents agreed “SA promotes recycling of renewable natural resources” and that “local farming practice impacts success of SA.” Ninety-four percent of respondents agreed “crop rotation was important to achieving SA.” In other words, SBAE educators firmly and consistently believed the following about SA: 1) that building up healthy soil was fundamental; 2) that conserving natural resources and recycling renewable ones was important for the future; 3) that crop rotation was significant; and 4) that agriculture was successful when it used and valued practices generated from local farmer.

Respondents displayed further belief in the alternative agriculture worldview in that there were three scale items that garnered a strong majority of agreement and were disagreed with only 2% of the time. Seven-eighths of respondents (85%) agreed they believed that SA benefited from the “exchange of knowledge about locally designed technologies among producers.” Over three-quarters (77%) of respondents agreed that “integra[ting]diverse crops with livestock promotes SA.” Seven-tenths (71%) of respondents agreed that “SA promotes local processing of agricultural production.” In other words, most SBAE educators believed the following about SA: 1) that it was important to allow for producers to disseminate information about locally designed technology amongst themselves; 2) that it was important to have production systems that integrated livestock and crops; and 3) it was important to have local processing centers for agricultural goods.

Belief in the alternative agricultural paradigm was mixed in terms of two scale items which received a majority of agreement but high frequencies of disagreement or neutrality. Over three-fifths (63%) agreed that “local knowledge of farming in a community was an indication of sustainability in agriculture.” However, it also received one of the highest frequencies of disagreement at 17%. Almost two-fifths of respondents (38%) responded neutrally that “SA promotes local marketing of agricultural production;” yet three-fifths (59%) agreed with the statement. In other words, a majority of SBAE educators believed the following about SA: 1) the presence of knowledge of production at the local level was important to agriculture; and 2) that agriculture should encourage local marketing of production. A large group of educators did not believe one way or the other regarding the relationship between local marketing and SA. A small group believed that the presence of local knowledge of production does not promote SA.

Respondents displayed support for the conventional agricultural paradigm on two scale items; however both received almost a majority of agreement. Respondents agreed less than half the time (48%) that “the size of a community impacts development of SA.” Less than a third (29%) disagreed. Respondents agreed less than half the time (48%) that “SA reduces need for external sources of inputs (48%).” Less than one-fifth (19%) disagreed. In other words, a very strong minority of SBAE educators believed the following about SA: 1) that community size was a factor that affected how agriculture developed; and 2) that implementing SA decreased the need for external inputs. However, a small group of educators did not believe either.

There were two items on which most respondents held a more convention agricultural worldview. Seven-tenths of respondents agreed with the two scale items that supported the conventional agricultural paradigm: 1) “SA promotes specialized crop and livestock enterprises (70%);” and 2) “innovations in agricultural technology determine the success of SA (71%).”

Disagreement with both occurred less than 10% of the time. In other words, most SBAE educators' conception of SA included the ideas that new technology determined how successful agriculture would be and that crop and livestock ventures should be specialized. Those were the only two items in which SBAE educators consistently held a strong conventional agricultural paradigm. These results appeared to contradict the 77% of respondents that agreed with item 6 that "integrating diverse crops with livestock promotes SA."

RQ 2c: Educators' knowledge of SA as measured by the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test. Table 7 displayed the mean cognitive test score, 7.3 out of 9 (SD =1.67), which meant that respondents were correct on about 80% of the test. One respondent left eight items unanswered; however, that was not the norm. SBAE educators' generally high scores indicated that they were fairly knowledgeable about SA fundamentals, meaning they understood that SA values the balance of social, economic, and ecological components on multiple levels. Their overall high scores on the cognitive test meant that respondents were familiar with the USDA's (and by default SARE) conception of SA.

Table 7
Mean, Standard Deviation, and Range of Scores for Cognitive Test Scores (n=47)

Knowledge of SA	Mean	SD	Min	Max
Cognitive Test	7.3	1.67	1	9

Table 8 provided the frequencies and percentages of correct and incorrect responses for individual scale items. For each item, four statements regarding SA were presented; respondents were asked to select the one true statement. Respondents were somewhat consistent in their item accuracy; correct responses ranged from 72 to 94 percent.

Individual scale responses indicated that across the board educators recognized SA necessitated protecting farm and natural resources. Fewer educators recognized that economic

Table 8
Frequency Distribution for Cognitive Test by Scale Item (n=47)

	Which of the following is true?	Correct		Incorrect	
		N	%	n	%
1	Farms and ranches need to be profitable to be sustainable	34	72	13	28
2	The site specific nature of SA makes farmer knowledge and experience critical to long term success	37	79	10	21
3	SA involves developing new methods that protect farm resources while maintaining economic viability	34	72	13	28
4	Many different kinds of farms can be sustainable	36	77	11	23
5	Stewardship of natural resources is critical to SA	44	94	3	6
6	The different components of the agricultural system, like production and marketing, affect each other	39	83	8	17
7	The transition to SA is a long-term, dynamic process	38	81	9	19
8	Farms and ranches need to be both profitable and environmentally sound	43	92	4	8
9	SA is producer-centered, but it encompasses issues related to the whole food system	36	77	11	23

viability is actually essential to SA as well. That analysis was drawn from the fact that almost all respondents correctly answered item 5 (94%) that "stewardship of natural resources is critical to SA;" they recognized that SA involved a consideration for the ecological component, in this case natural resources. However, one of the items most frequently incorrect responses was about profitability's place in sustainability; almost a third of respondents (28%) did not recognize that "farms and ranches need to be profitable to be sustainable (Item 1)."

Respondents were inconsistent in their understanding that SA requires both maintaining the environment and economic profitability. Almost all respondents agreed with item 8 (92%) that "farms and ranches need to be both profitable and environmentally sound." However, four educators (8%) answered incorrectly. In addition, a third answered item 3 incorrectly that "SA involves… protect[ing] farm resources while maintaining economic viability;"that was one of the most commonly missed scale items.

Respondents struggled with identifying SA within a greater context and the importance of producer centered knowledge within the larger system. A quarter of educators (23%) didn't recognize that SA involved making decisions about social, environmental, and economic factors at multiple levels as shown by item 9 "SA is producer-centered, but it encompassed issues related to the whole food system." About a fifth of respondents (17%) answered item 6 incorrectly that "different components of the agricultural system, like production and marketing, affected each other. About a fifth of respondents (21%) answered item 2 incorrectly that "farmer knowledge and experience were critical to long term success."

Some respondents also were not clear on what the process of SA consisted of or suitable places where the process could be used. A fifth (19%) of respondents incorrectly answered item 7 that "the transition to SA was a long-term, dynamic process." The data indicated that some educators did not know that SA involves applying varying solutions over a long period of time. Some educators struggled to understand the versatility of SA in terms of production scale and systems or the vastness of the systems involved. Almost a quarter of responders (23%) did not recognize that SA was adaptable and flexible to varying production scales and systems as indicated by item 4 that "many different kinds of farms can be sustainable."

RQ 2d: Educators' definitions of SA. Qualitative analysis was selected to provide an insider or "emic" account of the Michigan SBAE educators' conceptions of SA. That allowed for a comparison between SBAE educators' own conceptions and the concepts drawn from the literature such as the cognitive test. Thematic coding was selected to provide an interpretative analysis of the respondents' definitions of SA, which would determine some initial themes on a topic not widely researched. The data were analyzed in NVivo 9 and codes were identified inductively. After reading the data initially for codes, the codes were defined and refined. Data was reviewed twice more to further refine codes. Finally, individual summaries were written for the most salient codes, which have been labeled themes.

Two common themes emerged in how respondents defined SA: 1) Emphasis on the Ecological Dimension; and 2) Emphasis on Responsible Resource Management. While diversity existed among definitions, common responses included: “The process of producing agricultural products such as crops and livestock in ways that have the least impact on the environment and ensure that they will be able to be produced in the future.”

Emphasis on the ecological dimension. Respondents consistently discussed that the importance of considering the environment in decision making was significant to SA, although variance existed in magnitude and nature of that consideration. Conceptions were often vague, such as SA being an “environmentally responsible enterprise.” Specific examples listed as means to provide sustainability, included examples such as “by trying to reduce pollution as well as our carbon footprint.” SA was commonly discussed as a practice-based solution, which would assist in maintaining environmental integrity. Very few respondents addressed the consideration of the social aspects in SA; concepts that were introduced included: worker health, fair wages, consumer health, supporting rural communities, and making “socially acceptable decisions.” About 10% of respondents discussed the significance of an interrelationship between social, economic, and ecological factors in their definition.

Emphasis on responsible resource management. Careful decision making in managing resources appeared crucial in how respondents’ conceptualized SA. Respondents differed to some extent in how responsible resource management manifested. To some it meant maintaining natural resources, to others, not “significantly depleting” them, and to many, being “efficient” with these resources. Conservation and protection of both renewable and nonrenewable natural resources were discussed as important to maintaining sustainable production. To some respondents, being a good steward or using best practices was important to managing resources. Soil and water were the only resources specifically addressed repeatedly as important to manage. Renewable and non-renewable natural resources as broad categories were also mentioned repeatedly as needing proper management.

RQ 2e: Extent relationships exist between educators' NEP, ACAP, and cognitive test scores. Pearson's Correlational Coefficient was used to test for the presence of relationships between NEP, ACAP, and cognitive test scores; the results were presented in Table 9. A weak, positive relationship emerged between NEP and ACAP (r=.21) and a very weak, inverse relationship emerged between NEP and the cognitive test (r=-.11).No relationship existed between the ACAP and the cognitive test. Educators who tended to value a more eco-centric relationship with nature, tended to also held more eco-centric beliefs about agriculture as well. A more eco-centric relationship with nature was also slightly associated with less of an understanding of SA. Agricultural worldview was not associated with respondents' knowledge of SA. None of the results were significant; perhaps survey results weren't representative of the population.

Table 9
Pearson's Correlation of Relationships Between Ecological Paradigm, Agricultural Paradigm, and Knowledge of SA

	NEP	ACAP
ACAP	.21	-
Cognitive Test	-.11	.04

Note. Not sig at .05 level.

RQ 2f: Extent relationships exist between educators' NEP score and demographics. Demographic data were also collected to run correlations to determine whether relationships existed between demographics and NEP score. Point Biserial tested the relationship between the

NEP score and dichotomous data: gender and primary teaching setting. Cramer's V measured the association between the NEP score and the nominal data teaching region. Kendall's Tau tested the relationship between the NEP score and ordinal data: highest level of education and years teaching SBAE. Pearson's tested the relationship between the NEP score and the interval data age.

Table 10
Correlations of Relationships Between Ecological Paradigm and Demographics Measure of Association

Demographic	NEP Point Biserial	NEP Kendall's Tau b	NEP Cramer's V	NEP Pearson's
Gender	.02			
Primary Teaching Setting	-.12			
Highest Level of Education		-.17		
Years Teaching SBAE		-.07		
Teaching Region			.24	
Age				-.04

Note. Not sig at .05 level.

Correlations between NEP and demographic traits were presented in Table 10. No relationships emerged between NEP score and gender (.02), age (-.04), or years teaching SBAE (-.07). Very weak, negative relationships existed between NEP and primary teaching setting (-.12) and highest level of education (-.17). In other words, educators were slightly more likely to view the world ecologically with less higher education completed or if they were teaching at a CTC. A weak, positive relationship emerged between NEP and teaching region (.24), which indicated that ecological worldview was slightly different between teaching regions among the educators surveyed, but further analysis would need to be done to determine what the relationship looked like. None of the results were significant; again, perhaps survey results weren't representative of the population.

Findings for RQ 3: What are Michigan SBAE educators' in-service needs regarding their instruction of SAP and what are their priorities?

RQ 3a: Educators' in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model. The needs assessment asked respondents to: 1) rate how important teaching each agricultural practice, or competency, was to their classroom instruction; and 2) then rate their knowledge of each competency. Frequency distributions for the responses to each competency were presented in Table 11. Means, modes, and standard deviations for importance and knowledge of competencies were shown in Table 12.

Respondents valued each competency as important to instruction; means for the importance of teaching the competencies in the classroom were between 3.0 and 3.6, as demonstrated in Table 12. Overall, SBAE educators thought that all of the competencies, which included ten SAP and two conventional agricultural practices, were equally important to their students' agricultural education. Respondents rated Water Quality as the most important competency (M=3.6); 100% of respondents rated it important or very important as shown in Table 11.Six additional competencies received ratings of at least important by almost all survey respondents: 1) Composting (96%); 2) Crop Rotation (96%); 3) Integrated Pest Management (96%); 4) Nitrogen Cycle (97%); 5) Pest Resistant Crops (93%); and 6) Soil Conservation (96%). High numbers of SBAE educators felt that a majority of the competencies were important to their agricultural educational curriculum. Teaching about Water Quality was universally deemed important.

Knowledge means for six of the twelve competencies were less than 3.0 and the remaining had means no higher than 3.2 as illustrated in Table 12. SBAE educators considered themselves no more than slightly knowledgeable on half the competencies and not much more on

Table 11

Frequency Distributions for the Importance of Competencies in Instruction and Knowledge of Competencies (n=47)

Rate how IMPORTANT teaching the competency is to you in your classroom instruction:					Rate how KNOWLEDGEABLE you are in the competency:			
Very Unimportant	Unimportant	Important	Very Important	Competency	Unknowledgeable	Slightly Knowledgeable	Knowledgeable	Very Knowledgeable
0 (0%)	1 (2%)	33 (70%)	12 (26%)	Composting	0 (0%)	5 (11%)	35 (74%)	6 (13%)
0 (0%)	5 (11%)	36 (77%)	6 (13%)	Cover Cropping	1 (2%)	22 (47%)	18 (38%)	6 (13%)
0 (0%)	2 (4%)	29 (62%)	16 (34%)	Crop Rotation	0 (0%)	6 (13%)	29 (62%)	12 (26%)
1 (2%)	4 (9%)	30 (64%)	11 (23%)	Genetically Engineered Crops	0 (0%)	9 (19%)	33 (70%)	5 (11%)
0 (0%)	1 (2%)	23 (49%)	22 (47%)	Integrated Pest Management	0 (0%)	9 (19%)	30 (64%)	8 (17%)
1 (2%)	6 (13%)	32 (68%)	7 (15%)	Management Intensive Grazing	5 (11%)	22 (47%)	14 (30%)	6 (13%)
0 (0%)	7 (15%)	31 (66%)	8 (17%)	Mixed Farming	3 (6%)	11 (23%)	26 (55%)	7 (15%)
0 (0%)	1 (2%)	27 (57%)	19 (40%)	Nitrogen Cycle	0 (0%)	7 (15%)	28 (60%)	12 (26%)
1 (2%)	2 (4%)	33 (70%)	11 (23%)	Pest Resistant Crops	1 (2%)	13 (28%)	25 (53%)	8 (17%)
1 (2%)	4 (9%)	34 (72%)	7 (15%)	Reduced Tillage	3 (6%)	13 (28%)	26 (55%)	5 (11%)
0 (0%)	1 (2%)	22 (47%)	23 (49%)	Soil Conservation	0 (0%)	6 (13%)	31 (66%)	10 (21%)
0 (0%)	0 (0%)	19 (40%)	28 (60%)	Water Quality	0 (0%)	5 (11%)	28 (60%)	14 (30%)

Note. Importance Values: Very Unimportant=1; Very Important=4; Knowledge Values: Unknowledgeable=1; Very Knowledgeable=4; Not all frequency counts add up to (n=47) due to missing data; Percentages may not add up to 100% due to rounding.

Table 12

Ranked Competencies by Mean Weighted Discrepancy Scores (MWDS) and Means, Modes, and Standard Deviations for Importance of Competencies in Instruction and Knowledge of Competencies Related to Agricultural Practices (n=47)

Rank	Competency	MWDS	Importance			Knowledge		
			M	SD	Mo	M	SD	Mo
1	Integrated Pest Management	1.65	3.5	0.55	3	3.0	0.61	3
2	Management Intensive Grazing	1.49	3.0	0.61	3	2.5	0.86	2
3	Water Quality	1.46	3.6	0.50	4	3.2	0.61	3
4	Soil Conservation	1.36	3.5	0.55	4	3.1	0.58	3
5	Cover Cropping	1.22	3.0	0.49	3	2.6	0.74	2
6	Reduced Tillage	0.99	3.0	0.58	3	2.7	0.75	3
7	Nitrogen Cycle	0.94	3.4	0.53	3	3.1	0.63	3
7	Pest Resistant Crops	0.94	3.2	0.59	3	2.9	0.72	3
9	Composting	0.70	3.2	0.48	3	3.0	0.49	3
10	Genetically Engineered Crops	0.61	3.1	0.64	3	2.9	0.55	3
11	Mixed Farming	0.59	3.0	0.58	3	2.8	0.78	3
12	Crop Rotation	0.56	3.3	0.55	3	3.1	0.61	3

Note. MWDS = Mean Weighted Discrepancy Score; Importance Values: 1=Very Unimportant; 4=Very Important; Knowledge Values: 1= Unknowledgeable; 4=Very Knowledgeable; Mo = Mode.

the remainder. Despite SBAE educators feeling that each of the competencies were important for their students to learn, as a group they did not have a strong command of many of them. Respondents rated themselves as the most knowledgeable about Water Quality (M=3.2) and the least knowledgeable of Management Intensive Grazing (M=2.5). At least one fifth of respondents felt very knowledgeable about four competencies: 1) Crop Rotation (26%); 2) Nitrogen Cycle (26%); 3) Soil Conservation (21%); and 4) Water Quality (30%).

Table 12 showed that respondents considered four competencies equally the least important to instruction (M=3.0): 1) Management Intensive Grazing; 2) Mixed Farming; 3) Cover Cropping; and 4) Reduced Tillage. Management Intensive Grazing and Mixed Farming were the two competencies most frequently rated unimportant; one seventh (15%) of respondents considered both unimportant to their instruction. In addition, the two competencies were among those that respondents felt the least competent. Almost two-thirds (58%) and over a quarter (29%) of respondents considered themselves no more than slightly knowledge of Management Intensive Grazing and Mixed Farming, respectively. Around 90% of respondents considered Cover Cropping important, but half (49%) were no more than slightly knowledgeable of the competency. Approximately 90% of respondents rated Reduced Tillage as important, however, a third (34%) considered themselves no more than slightly knowledgeable of it.

Respondents rated the two typically conventional agriculture practices – Genetically Engineered Crops and Pest Resistant Crops – nearly identically. Overall, they felt that both were important to their instruction (M=3.1; M=3.2) and felt slightly unknowledgeable about both (M=2.9). Ratings for the conventional practices were very consistent with ratings for the competencies that were SAP. The consistencies suggested that SBAE educators' valued instruction of a range of skills that included both Genetically Engineered Crops and Pest

Resistant Crops and the listed SAP. Overall, SBAE educators felt they lacked proficiency of the two conventional practices and SAP alike.

RQ 3b: Prioritize educators' in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model. The Mean Weighted Discrepancy Score (MWDS) was calculated for each competency. The higher a competency's MWDS, the higher a demonstrated need for instructional support for that competency; competencies were ranked by MWDS as shown in Table 12. Respondents' top five competencies were: 1) Integrated Pest Management (MWDS=1.66); 2) Management Intensive Grazing (MWDS=1.49); 3) Water Quality (MWDS=1.46); 4) Soil Conservation (MWDS=1.36); and 5) Cover Cropping (MWDS=1.22). The competencies Pest Resistant Crops and Genetically Engineered Crops, the two more conventional agricultural practices, ranked seventh (MWDS=0.94) and tenth (MWDS=0.61) respectively. Respondents reported identical in-service need for the two competencies Pest Resistance Crops and Nitrogen Cycle (MWDS=0.94).

CHAPTER V

Conclusions, Discussion, Recommendations, and Recommendations for Further Study

Summary of the Study: Purpose and Research Questions

The purpose of this study was to: 1) determine the demographic composition of Michigan SBAE educators; 2) establish a baseline of attitudes, beliefs, perceptions, and knowledge of SA among Michigan SBAE educators; and 3) determine and prioritize educator in-service needs regarding their instruction of SAP. The following research questions guided the study:

1. What is the demographic composition of Michigan SBAE?
2. What are the attitudes, beliefs, perceptions, and knowledge of SA among Michigan SBAE?
    a. What is their ecological paradigm as measured by the NEP?
    b. What is their agricultural paradigm as measured by ACAP?
    c. What knowledge do they possess of SA as measured by the SARE "Sustainable Agriculture: Principles and Concept Overview" cognitive test?
    d. How do they self-define SA?
    e. To what extent do relationships exist between their scores on the following:
        i. The NEP and the ACAP
        ii. The NEP and the cognitive test
        iii. The ACAP and the cognitive test
    f. To what extent do relationships exist between their demographics and NEP score:
        i. Age
        ii. Gender
        iii. Primary Teaching Setting

iv. Region

v. Years teaching SBAE

vi. Highest Education Completed

3. What are Michigan SBAE in-service need regarding their instruction of SAP and what are their priorities?
   a. What are their in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model?
   b. What are the priorities of SBAE educator in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model?

Methodology

The descriptive, exploratory research study surveyed Michigan SBAE about their ecological paradigm, agricultural paradigm, knowledge of and conceptualization of SA, and their in-service needs regarding their SAP instruction. Teachers teaching during the 2011-2012 school year were targeted and the population frame was drawn using the 2011-2012 Agriculture, Food, and Natural Resource Directory obtained from the Michigan FFA Association. A census (n=104) of the population received the survey. The survey was constructed using and data managed with the online software Qualtrics. The survey consisted of the following existing scales: 1) the NEP; 2) the ACAP; and 3) the SARE cognitive test. A single, original qualitative scale item solicited participants' definitions of SA. The survey included a needs assessment based on Borich's Model to evaluate the SBAE educators' competency of and the reported importance of teaching a selection of agricultural practices. The agricultural practices were selected from the literature and included 10 SAP and 2 conventional agricultural practices. Demographics were also collected. The reliability, face validity, and content validity of the three existing scales were established through a piloting by experts. Internal reliability was determined for the NEP and the ACAP using Cronbachs alpha and for the cognitive test using Kuder Richardsons 20. Bivariate Correlations using Pearson were used to obtain test-retest reliability for the ACAP; concerns about internal consistency resulted in the removal of 6 subscale items.

An initial notification was emailed prior to data collection. An invitation to the survey was emailed to each member of the sample, followed by up to three email reminders. A total of 47 completed surveys and 3 incomplete surveys were collected for a response rating of 45%. Independent t-tests and a Pearson Chi-square were utilized to test for non-response error. Despite the low response rate, there were no significant differences between the ecological worldview or agricultural worldview of the survey respondents and the greater population. However, females (Chi-square=4.81; p=0.03) and SBAE educators who taught at CTC's (Chi-square=4.90; p=0.03) were significantly more likely to respond to the survey than males and high school educators. Therefore, only the NEP and the ACAP results can be generalized to the Michigan SBAE educator population.

Quantitative data analysis was conducted using SPSS version 19.0 and qualitative data was analyzed using Nvivo 9. The research questions were answered using descriptive statistics, frequencies, crosstabs, and correlations. Where correlations were tested, the following coefficients were used: Pearsons, Point Biserial, Kendall's Tau, and Cramer's V. The qualitative data were analyzed using thematic coding to provide an interpretative analysis of the responses.

Conclusions for RQ 1: What is the demographic composition of SBAE educators?

Survey respondents were primarily female, were in their late 20's or 30's, had a Master's degree, and worked at a CTC. Female Michigan SBAE educators were twice as likely to participate in the survey as their male counterparts, despite that there were nearly equal population frequencies of each gender. Of the CTC based educations surveyed, over two-thirds (66%) participated, compared to two-fifths (42%) of high school based ones. Respondents were slightly more likely to teach in Regions 5 or 6, while the remaining regions were less so but similarly represented; it was not clear why. As was earlier determined with non-response error, females and educators who worked in CTC's were significantly more likely to respond to the survey. That meant survey results could not be generalized to the population of Michigan SBAE educators. It was not clear why more females and educators from CTC participated.

Due to a lack of population data, comparisons between survey respondents and Michigan SBAE educator population could not be made concerning age, years teaching SBAE, or highest degree obtained. The majority of respondents were between the ages of 25-40.They were just as likely to be in their late 20's as their 50's. The age data paralleled the data about how many years educators had been teaching. Respondents were fairly equal in their experience from 0 to 15 years of teaching; a strong minority had been teaching AFNR for more than 26 years. Again, perhaps these particular age groups of educators found the topic of survey particularly relevant to their career.

Conclusions for RQ 2: What are SBAE educators attitudes, beliefs, perceptions, and knowledge of SA?

RQ 2a: Educators' ecological paradigm as measured by the NEP. Michigan SBAE educators' held a slightly eco-centric paradigm, which meant that overall they viewed their relationship with the environment as somewhat of an ecological one, one that was somewhat mutually beneficial. However, when frequencies were examined at the subscale level and at the individual scale item level, SBAE educators were actually very heterogeneous in their EA. Most individual scale items did not garner a majority of agreement or disagreement and bimodal populations of varying magnitudes emerged. Two exceptions to the inconsistencies were visible: 1) almost every respondent thought that humans were subject to nature's laws; and 2) a strong majority of respondents thought that the balance of nature was fragile. These inconsistencies were discussed under their respective subscales below.

It was not clear why the educators were so diverse in their responses or why these two trends emerged from their generally heterogeneous EA. However, it can be assumed that the NEP results represent the Michigan SBAE educator population because the independent t-test which determined non-response error indicated there were no significant differences between respondents and non-responders NEP scores. The overall lack of homogeny on most of the subscales indicated that the population had bimodal tendencies in terms of their EA. The results of the correlations that were run and the implications of the existence of a bimodal population will be discussed further in the chapter. No significant relationships (or even moderate in strength) were found between the NEP scale and demographics, the ACAP scale, or the cognitive exam on SA. In terms of demographics, NEP results did not significantly correlate with the participant's gender, age, number of years teaching SBAE, the region or setting they taught in, or their highest level of education.

Large frequencies of SBAE educators didn't respond one way or another regarding their environmental attitudes. On seven out of fifteen items, approximately a third of responses were neutral; six additional items had neutral responses 20-25% of the time. The two most common neutral items were "plants and animals have as much right as humans to exist" (34%) and "when humans interfere with nature, it often produces disastrous consequences (34%)." One possible reason for the neutral data could be that educators were an unwilling to document their attitudes on a survey sourced from a colleague. An alternative is that despite the reliability of the scale, the language of some of the sub-scales could have appeared loaded and biased such as the concept of the "ecological crisis."

Reality of limits to growth. Respondents held consistently contrasting attitudes regarding the existence of (and the current proximity to) a finite boundary to the growth of the human population, available space, and natural resources. The responses were slightly bimodal. For each subscale, responses were somewhat consistent, with approximately half of respondents agreeing, a quarter of respondents disagreeing, and a fifth to a quarter answering neutrally. Over half of the respondents thought that there were real limits to growth in terms of the human population, resources, and available space; they also thought that humans were nearing that boundary limit. Approximately half of respondents thought that the earth had an abundance of natural resources waiting for proper human development; however, a quarter thought natural resources did have limitations. A quarter of respondents did not think that there were limits to the human population, or space available and therefore, that society was not nearing a population limit. As with the above items, no significant (or even moderate) relationships were found between the NEP scale and demographics, the ACAP scale, or the cognitive exam on SA.

Antianthropocentrism. Respondents' attitudes were bimodal in how they viewed nature's purpose and value. That included division over each subscale: 1) the attitude that man could submit the environment to his will; 2) that man's rightful place was dominating nature; and 3) the idea that plants and animals were due an entitlement to life. Respondents were nearly evenly divided about whether mankind is meant to hold dominion over the natural world. Some similarities did exist; over two-fifths of respondents thought that humans do not have a right to alter the natural world to fulfill their own purposes and that plants, animals, and humankind have equal rights to exist. However, over a third of respondents thought that humans do have the right to alter the natural environment to suit their needs. A quarter thought that nature does not have the same right to exist as humankind.

The high percentages of neutral responses suggested that many respondents had difficulty selecting a response that fit their attitudes on the subscale. A third of respondents, a large amount, did not indicate one way or another their attitudes regarding whether mankind holds more claim to exist than plants and animals or whether mankind is meant to rule over those plants and animals. One possibility could be that the language the subscale was written in was not entirely neutral.

Fragility of nature's balance. A strong majority of respondents generally thought that they must operate in harmony with nature laws to maintain the existence of humankind; this scale was one of two where a strong majority of respondents agreed about their EA. The subscale concerning the fragility of the nature's balance had two individual scale items that received uncommon majorities of agreement and it was the only subscale in which respondents were somewhat consistent in their worldviews. The two items that two thirds of respondents agreed with were that 1) nature's workings could be easily disrupted (66%); and 2) that nature cannot overcome the consequences of our highly industrialized world (62%). So while, overall, the SBAE educators did not agree as a strong majority on almost all of the individual scale items across the entire NEP, the majority did share a worldview in which nature was fragile and unable to withstand the effects of our current industrial world.

However, there still existed a small selection of respondents who thought, somewhat contradictorily, that nature is resilient enough to handle the effects of the modern, industrial world and that humankind's actions in the world would not spell disaster for nature. In addition, a third of respondents did not agree or disagree with the attitudes about whether human interference with nature has incredibly severe consequences or whether the balance of nature is delicate. The levels of neutrality about both seemed disconnected from the strong numbers of respondents who thought the balance of nature was fragile.

Rejection of exemptionalism. The subscale was the second instance where respondents strongly agreed on an individual scale item, however, the overall subscale results indicated that there was still a bimodal population. It was impressive that nearly all respondents thought that humans did not operate outside of the laws of nature. Though the concept resonated with SBAE educators, the strong support was somewhat misleading since there were varying degrees of disagreement within the subscale. Half of respondents did think that humankind will never possess enough knowledge to exert control over nature. However, a fifth of educators disagreed and over two fifths thought that human ingenuity will aid in preventing the earth from being unlivable. The support for the former EA about eventually learning how to control nature was outright contradictory to the near unanimous agreement that humans were bound by the laws of nature. As with the other subscales, less than half as many respondents believed in the opposite of each. Overall, many respondents thought that while human ingenuity could assist man in preserving the earth, human knowledge would never be enough to control it.

Two scale items elicited neutral responses from a third of the sample, which could have resulted from the items being written in a language that is not entirely neutral. There were also EA from other subscales that educators held which contradicted their en mass support for the EA about being bound to nature's laws. Over a third of respondents thought that they could modify the natural world for their own gain and the same number thought that humans are meant to rule over the rest of nature. Respondents clearly held both eco-centric worldviews and anthropocentric worldviews about whether or not humans were exempt from nature's constraints.

Possibility of eco-crisis. Respondents held clearly distinct and opposing attitudes regarding the probability that an ecological catastrophe would affect humankind. Just less than half of respondents thought that certain human interactions with the world could be labeled abusive, that our current means of living will lead to an eco-crisis, and that the idea eco-crisis was reasonable and valid. In contrast, a third of respondents thought that the eco-crisis concept was an exaggeration of reality. Also, about a quarter of respondents thought that the human impact on the world was not abusive and that humankind faces no threat of an eco-catastrophe. The clear division in EA between respondents indicated that educators form a bimodal population in terms of their attitudes regarding the existence of and likelihood of an ecological catastrophe. A third of respondents felt neutrally about the impending ecological disaster scale item; the language in the scale item may be biased and should be examined.

RQ 2b: Educators' agricultural paradigm as measured by the ACAP. Michigan SBAE educators' overall moderate beliefs about SA meant that they held a moderately alternative agricultural worldview (M=3.79). In other words, in general, SBAE educators' conception of agriculture considered a relationship between nature and humankind. Interestingly, respondents as a whole consistently believed in an alternative agricultural paradigm on the majority of the scale items. However, division did exist among the remaining scale items, and the reasons why were unclear. There was almost universal belief in the alternative agricultural paradigm on five of the 14 scale items. In addition, between 70-85% respondents believed in the alternative agricultural paradigm on 3 more scale items, each of which also garnered less than 3% disagreement. In particular, SBAE educators very strongly believed in a SA paradigm where: 1) developing healthy soils was vital and crop rotation was key that to that process; 2) it was important to conserve natural resources and recycle renewable ones for the next generations; 3) valuing and using local, farmer generated practices led to successful farming; 4) it was important to allow for producers to disseminate information about locally designed technology amongst themselves; 5) production systems should integrate a diversity of livestock and crops; and 6) it was important to have local processing centers for agricultural goods.

There were four scale items where respondents displayed mixed agricultural beliefs about SA, they concerned: 1) the importance of local production knowledge; 2) whether SA fosters local production marketing; 3) the role of community size in the development of agriculture; and 4) whether SA reduces the need for external inputs. While a majority of SBAE educators believed that in SA knowledge of production at the local level was important to production; almost one-fifth did not believe that producer centric knowledge was valuable. Perhaps their agricultural paradigm placed a greater value on the institutional knowledge that has been disseminated to producers. A slight majority of SBAE educators also believed agriculture encouraged local marketing of agricultural goods. Almost two-fifths were unsure; that was quite a large minority of educators that are skeptical that SA could be a viable approach to promote local marketing for producers. The role of community size and external inputs in SA were even more contentious among respondents. Not quite half of SBAE educators believed the following about SA: 1) community size affected the development of agriculture (while 30% disagreed); and 2) that implementing SA decreased the need for external inputs (while 20% disagreed).

The majority of respondents believed in both conventional agricultural scale items which meant for those two beliefs they favored the conventional agricultural paradigm. The majority of SBAE educators' believed that in SA, new technology determined how successful agriculture would become (71%) and that SA promoted specialized crop and livestock systems (70%). Interestingly, out of all the scale items, those were the only two practices in which the majority of SBAE educators believed in the conventional agricultural paradigm. It could have been a coincidence that the majority of educators believed in all the other scale items, all of which favored the alternative agricultural paradigm. However, the results did contradict another belief, over three quarters of respondents believed that integrating diverse crops with livestock promoted SA. It is unclear why the SBAE educators believed in the two conventional practices included in the survey or why they simultaneously believed in two contradictory beliefs regarding specialization versus the diversification of livestock and crops. The SBAE educators appeared to hold somewhat complex beliefs about agriculture.

RQ 2c: Educators' knowledge of SA as measured by the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test. Michigan SBAE educators overall had a strong grasp of the fundamental concepts of SA. However, a subset did have difficulty identifying that SA: 1) was an integrated food system that addressed issues throughout a larger system; 2) that its scope was not just environmental factors but that it considering and balancing social and economic factors too; and 3) that SA was an approach rather than a set of practices and where the approach could be implemented. Somehow the information that has been disseminated to SBAE educators about SA over time has either been somewhat inaccurate or incomplete. However, SBAE educators continually expand their education throughout their career, whether that's formally through CE, or informally through their relationships with institutions like MSU. Especially with the changes in curriculum discussed in Chapter 1, it seemed strange that a sizeable chunk had missed the mark when SA has been a common topic of discussion in their profession. A correlation was not run between the cognitive exam scores and demographics to clarify whether there may be certain demographic factors that were more likely to be associated with lower scores on the cognitive exam. The percentage of those who have been teaching longer than 15 years made up about 25% of the sample, which seemed similar in frequencies to some of the incorrect answers on the cognitive exam. While the truth was probably more complicated than this, perhaps the older educators that have been teaching more than 15 years were more likely to be less aware of the larger system of SA.

Almost universally respondents understood that SA included systems that protected natural resources; that was consistent with their near universal belief that SA conserves natural resources for future generations from the ACAP. However, nearly a third did not understand that SA existed within an integrated system, one which must also be economically viable. That was the first time any of the scales in the overall survey specifically asked about economic viability and no other question on the cognitive exam was missed more often than the two about profitability. Again, this suggested there had been inaccurate or incomplete information being disseminated about SA to SBAE educators since approximately a third of them did not recognize the importance of profitability within SA.

Also missing from their understanding of SA was that these were systems that must be socially sustainable as well; nearly a fifth of educators struggled with the social factors. About a fifth of educators did not understand that local producer knowledge and experience were vital to a successful SA system. That misunderstanding overlapped with SBAE educators' agricultural belief from the ACAP about local producer knowledge and SA; almost a fifth didn't believe local knowledge of farming in a community was an indication of sustainability in agriculture.

Respondents also struggled with the idea that SA was an approach that existed within a greater, interrelated system. A sizeable subset of respondents struggled with the idea that SA addressed not just the producer, but the larger, interrelated food system the producer was a part of. Almost a quarter of educators didn't understand that SA "encompasse[d] issues related to the whole food system" and almost a fifth of educators did not know that "components like marketing and production affect[ed] one another." In other words, about 20% of educators seemed to have a very limited and incomplete scope of what SA addressed. Almost a fifth didn't know that SA was not a single process but rather an approach that was adaptable to many types of production systems. That was the first time in the scales that a question asked about whether SA was a process versus an approach and where SA would be applicable; that 20% of SBAE educators were incorrect that SA was an approach was surprising.

RQ 2d: Educators' definitions of SA. Overall, Michigan SBAE educators most frequently conceptualized SA as a practice-based process that involved making environmentally acceptable decisions to maintain the supply of food and fiber. Only 10% of educators specifically stated that it involved a balanced system of relationships between social, economic, and ecological factors. Two common themes emerged in how respondents defined SA: 1) Emphasis on the Ecological Dimension; and 2) Emphasis on Responsible Resource Management.

There seemed to be inconsistencies between the quantitative and the qualitative data. When the results from the cognitive exam and the ACAP were examined on an individual scale item basis, there was strong support for the two themes that emerged from the qualitative data, especially from the former. However, when the means of the two scales were compared to the qualitative findings, the parallel in the data disappeared. Only 10% of educators specifically stated in their definitions that SA involved a balanced system of relationships between social, economic, and ecological factors. However, in the cognitive exam, the mean was 7.3 (out of 9), which meant that educators had about an 80% accuracy rate about the fundamentals of SA. The same disconnect occurred with the ACAP, the mean was 53.1 (out of 70). The majority of the scale items received a strong majority of support for the alternative agricultural paradigm and indicating an understanding of SA. It's not clear why the when educators were prompted to write about SA in their own words, they were not as comprehensive in their answers as they had been with the ACAP and the cognitive exam.

Emphasis on the ecological dimension. Many educators saw SA as the running of an "environmentally responsible enterprise" that could maintain agricultural production levels. One respondent's definition of SA was common: "The process of producing agricultural products such as crops and livestock in ways that have the least impact on the environment and ensure that they will be able to be produced in the future." In general, SBAE educators envisioned SA a process that involved consideration of the environment when making decisions about crop and/or livestock production. However, many educators were vague in how SA could be environmentally responsible or the types of outcomes that were important to be environmentally conscious. One educator did specify an example of how the environment was considered during production suggesting "trying to reduce pollution as well as our carbon footprint."

Most notably absent from their definitions were economic or social factors. A tenth of educators specifically included the social, ecological, and economic components of SA; they tended to provide specific examples of social factors to consider. Within that subset of respondents was the only discussion of social sustainability at all. The social factors that were discussed by that small subset were: worker health, fair wages, consumer health, and supporting rural communities. Maintaining, and sometimes enhancing the food and fiber supply, was discussed frequently in educator definitions. However, the idea of SA being economically profitable was only discussed by a handful of educators outside of the 10% that conceived of SA as a complete, interrelated system. Unfortunately, the discussion of the economic factors in SA was fairly vague. One common example of the inclusion of the economic consideration was "continued profitability without jeopardizing the environment."

The emphasis of SA being "environmentally friendly" in the educators' definitions and the limited discussion of the social and economic factors was reflected in the quantitative data as well. In the cognitive exam, a third of educators did not understand that SA systems must be economically viable and about a fifth did not recognize the value that SA places on social considerations. It appeared that only a small subset have a clear and complete understanding of SA as an interrelated system of economic, social, and environmental factors. Unfortunately, no analysis was run to determine whether patterns existed between that subset and the demographics collected. Amongst the remaining SBAE educators, they tended to equate SA with some vague notions of environmental protection and lacked a clear understanding of the fundamental roles of the social and economic factors. When economic factors were discussed, it was in vague terms although social factors were specific, addressing the production workers, the consumer, and the surrounding communities. The lack of specifics could have resulted from the prompt not asking the respondents to provide specifics.

Emphasis on responsible resource management. Michigan SBAE educators also consistently conceived of SA as a process of careful decision-making in managing resources. However, they were not very specific regarding what resources were important manage and were varied in the extent resources should be managed. Respondents felt that it was important to preserve and maintain agriculture for generations to come and their definitions often specifically listed managing resources as means to do so. Protecting and recycling renewable resources and conserving non-renewable natural resources were included; however, soil and water were the only two resources mentioned as important to properly manage. Soil was mentioned about 10%

of the time and water approximately 5% of the time. Educators were also vague and inconsistent regarding what management should look like. Some thought of management of resources as not "significantly depleting," them while others thought that it meant being "efficient" with them. Even the idea of not "significantly depleting" a resource highlighted the struggle some experienced defining SA since depletion of a resource to any degree was not sustainable. The lack of specifics regarding resources and the extent they should be managed could have been the result of the question not asking them to be specific in their responses. Another possibility could be that some respondents didn't know how to conserve or protect resources in a sustainable way.

The qualitative data regarding their beliefs that SA involved managing natural resources (both renewable and non-renewable) in a responsible manner was supported by the quantitative data from the ACAP and the cognitive exam. In the cognitive exam, almost all the educators correctly answered that SA included the stewardship of natural resources. On the ACAP, there was near universal belief that 1) SA conserves natural resources for future generations; and 2) SA promotes the recycling of renewable natural resources. Interestingly, while only 10% specifically discussed soil conservation in their definition of SA, in the ACAP almost every respondent believed that SA valued the development of healthy soil. Again, the lack of specifics could have been a result of the prompt not requesting specifics in their responses.

The overlap in qualitative and quantitative in terms of resource management meant that generally SBAE educators understand SA to revolve around the proper management of renewable and non-renewable resources to maintain production of agriculture. The varied degree and somewhat vague way resources should be protected and managed indicated that either some didn't know how SA does this or they didn't get specific because they question didn't prompt them too. It was not clear why SBAE educators' conceptions of SA so consistently included proper resource management; no relationships were analyzed to examine patterns with demographics for example.

RQ 2e: Extent relationships exist between educators' NEP, ACAP, and cognitive test scores. Michigan SBAE educators did not have any significant relationships between their beliefs about agriculture, their environmental attitudes, or their conceptual knowledge of SA. Normally that would indicate that there were not any significant relationships between these variables among the greater Michigan SBAE educator population as well, however, that was difficult to determine. Independent t-tests revealed that the NEP and ACAP scores of the sample did represent the population; however, a Pearson Chi-square indicated that the remainder of the results, such as their knowledge of SA, could not be generalized to the population since significantly more females and CTC instructors participated.

There was a very slight, weak correlation (.21) between respondents' EA and their agricultural beliefs. In other words, those who viewed their relationship with the environment as more ecological were more likely to view agriculture through an ecological lens as well. It was somewhat surprising that the relationship wasn't stronger between the ecological paradigm and the agricultural paradigm, but the lack of a stronger relationship was about the difference between scales and not about the respondents themselves. An even smaller, but strange inverse relationship (-.11) developed between environmental attitudes and conceptual knowledge of SA. Interestingly, the more respondents' had an ecological relationship with the natural world, the more likely they were to misunderstand what the fundamentals of SA were. However, it was possible that one could hold general environmental attitudes without actually being completely knowledgeable of SA. There was no relationship (.04) between respondents' agricultural worldview and their knowledge of SA.

RQ 2f: Extent relationships exist between educators' NEP score and demographics. Michigan SBAE educators couldn't be differentiated by their environmental attitudes based on their demographics since none of the results were significant. No relationships emerged between respondents' environmental attitudes and their gender, age, or the length of time they've taught SBAE. Normally, that would again indicate that these relationships also did not actually exist amongst the Michigan SBAE educator population as well. However, because the independent t-test determined that the NEP scores of the sample did represent the population but the Pearson Chi-square revealed that the remainder of the results could not be generalized to the population because of gender and teacher setting, it was difficult to determine.

Very weak, negative relationships existed between their environmental attitudes and primary teaching setting and highest level of education. In other words, there was a slight association (Point Biserial -.12) between viewing the world more ecologically and teaching at a CTC. Perhaps the types of educators that have been drawn to teaching at a CTC already had a slightly more ecological worldview and/or the culture within CTCs themselves was more ecologically oriented. In addition, a slight probability existed that those with a more ecological worldview had obtained less higher education (Kendall Tau b -.17). Since there was no relationship between NEP and age, perhaps the reason has something to do with the educational experience at the Bachelor's level in comparison to that at a Master's and Doctorate level. Perhaps the agricultural instruction and/or culture of the programs at the Bachelor's level included more discussion of SA. A weak, positive relationship emerged between NEP and teaching region (Cramer's V .24), which indicated that there was a slight association between environmental attitudes and teaching region. Additional tests would need to be run to determine what regions were associated with higher NEP scores.

Conclusions for RQ 3: What are Michigan SBAE educators' in-service needs regarding their instruction of SAP and what are their priorities?

RQ 3a: Educators' in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model. Respondents indicated that each of the 12 competencies selected from the literature were important to their classroom instruction. Based on a scale from 1 (very unimportant) to 4 (very important), importance means ranged between 3.0 and 3.6; in other words, educators deemed each of the SAP and the two conventional agricultural practices as important topics to discuss with their students. In addition, the majority of the competencies (7 out of 12) were actually almost universally rated important (either a 3 or 4) by all survey respondents. Those included: 1) Water Quality (100%); 2) Composting (96%); 3) Crop Rotation (96%); 4) Integrated Pest Management (96%); 5) Nitrogen Cycle (97%); 6) Pest Resistant Crops (93%); and 7) Soil Conservation (96%). Interestingly, the Pest Resistant Crops topic was one of two conventional practices and was favored by almost everyone. Five competencies that were the least important (between M=3.0 and M=3.1) to instruction were: 1) Genetically Modified Crops; 2) Mixed Farming; 3) Cover Cropping; 4) Management Intensive Grazing; and 5) Reduced Tillage. Despite ranking as least important among the list of 12 practices, these SAP were still considered important by at least 85% of instructors.

Despite that some SBAE educators had incomplete pictures of SA, as indicated by the results of the cognitive exam and their own definitions of SA, educators deemed each of the practices important to include in their classroom instruction. Although no analysis was run, it appeared that despite the educators mixed EAs, the majority of the practices were still overwhelmingly important to the agricultural education they were providing their students. The fact that they also considered the two conventional agricultural practices- Genetically Modified

Crops and Pest Resistant Crops - important meant that probably still think that a range of practices important. Again it was unclear why educators overwhelmingly found these topics important to classroom instruction; no analysis was run to determine whether relationships might exist with other variables like demographic traits.

SBAE educators were right on the cusp between slightly knowledgeable and knowledgeable of the competencies (M=2.91). The analysis was based on a scale from 1 (unknowledgeable) to 4 (very knowledgeable), where their competency knowledge means ranged between 2.5 and 3.2. Respondents rated themselves as the most knowledgeable about Water Quality (M=3.2). Over 65% of respondents considered themselves knowledgeable or very knowledgeable on five-sixths of the competencies: 1) Water Quality (90%); 2) Crop Rotation (88%); 3) Composting (87%); 4) Soil Conservation (87%); 5) Nitrogen Cycle (86%); 6) Genetically Engineered Crops (81%); 7) Integrated Pest Management (81%); 8) Mixed Farming Cycle (70%); 9) Pest Resistant Crops (70%); and 10) Reduced Tillage (66%). What the frequencies demonstrated was that while some SBAE educators were unclear about what SA meant, the vast majority claimed a huge existing knowledge base for almost all the SAP. Again, it is unclear what to attribute the strong knowledge base to, further research would need to be conducted to run an analysis.

Very few educators claimed they were completely unknowledgeable about a competency. Educators felt the least knowledgeable of Management Intensive Grazing (M=2.5) which received the highest frequency of those who stated they were unknowledgeable about it (11%). However, many educators felt no more than “slightly knowledgeable” on many competencies: 1) Management Intensive Grazing (58%); 2) Cover Cropping (49%); 3) Reduced Tillage (34%); 4) Pest Resistant Crops (30%); 5) Mixed Farming (29%); 7) Genetically Engineered Crops (19%);

and 7) Integrated Pest Management (19%). Clearly Management Intensive Grazing and Cover Cropping were the two practices where there was the largest knowledge deficit. Interestingly, respondents rated Genetically Engineered Crops and Pest Resistant Crops important to their instruction (M=3.1; M=3.2) yet felt equally slightly unknowledgeable about both (M=2.9).

RQ 3b: Prioritize educators' in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model. A list of ranked priorities was created through the use of the model which considered the perceived significance specific SAP instruction played in Michigan SBAE educators' classroom and their perceived knowledge of those SAPs. The following 5 competencies were indicated by SBAE educators as their highest priorities for in-service: 1) Integrated Pest Management (1.65 MWDS); 2) Management Intensive Grazing (1.49 MWDS); 3) Water Quality (1.46 MWDS); 4) Soil Conservation (1.36 MWDS); and 5) Cover Cropping (1.22 MWDS).

Strategies to manage pests were among the most prevalent areas of need that emerged. Integrated Pest Management was the first priority and while the Pest Resistant Crops competency was not ranked among the top 5, it was almost universally important to instruction among the respondents. Pest Resistant Crops can be used in combination with other strategies under an Integrated Pest Management approach. In addition, Cover Cropping was the fifth ranked priority, and it too has been used as an Integrated Pest Management strategy. Management Intensive Grazing was the second priority. That Water Quality was the third highest priority was not surprising since the educators lived in a state surrounded by the Great Lakes. Soil development and conservation were areas of need that spanned multiple competencies, for instance the Soil Conservation competency was almost unanimously agreed as important to classroom instruction. SBAE educators ranked Soil Conservation as the fourth priority and

Cover Cropping fifth; one of the main goals in using Cover Cropping has been to protect soil from erosion and pests. With the exception of Water Quality, it's not clear why educators prioritized these needs for in-service over the other competencies.

While the model takes into consideration importance to instruction and perceived knowledge of the competencies, two points of concern arose with the ranked priorities. Management Intensive Grazing (Importance M=3.0; Knowledge M=2.5) and Cover Cropping (Importance M=3.0; Knowledge M=2.6), were the two competencies in which educators overall had indicated the largest deficit in knowledge and in which educators felt were the least important to classroom instruction. The standard deviation for knowledge of Management Intensive Grazing (SD=.86) and Cover Cropping (SD=.74) were much higher than any other of the top 5 priorities. The standard deviation for importance of Management Intensive Grazing to instruction was also much higher too than other top 4 (SD=.61). In terms of frequencies, the range of responses included over a tenth of respondents who didn't think that the competencies were important to classroom instruction (Management Intensive Grazing 15%; Cover Cropping 11%). Perhaps the reason that a portion of the tenth of educators who were unknowledgeable about Management Intensive Grazing and nearly half had only a little knowledge about it (47%) and Cover Cropping (47%) was because they didn't find them important. The implications were that in-service may need to be tailored differently for these two competencies, perhaps including how valuable each competency could be in production systems. Those implications will be discussed under recommendations.

Discussion for RQ 1: What is the demographic composition of SBAE educators?

This research question was asked to understand who the SBAE educators were and later to determine if their demographic traits correlated with their EA. Interestingly, gender has been skewed in several studies. Female student teachers made up at least 80% of survey respondents in the international study on preservice; however, Watson and Halse (2005) reported that the results were generalizable. The researchers stated that the results were not uncommon since internationally students in teacher education tended to be female. A highly skewed sample was also present in Muma et al. (2010), Okeafor (2002), and Williams and Wise (1997); however, it was males who made up over 80% of respondents in all three. It appeared that they were all generalizable to their populations as well. Williams and Wise (1997) drew their sample from Iowa and the other two samples were drawn from the 12 states that made up the Northwest Region, which included Michigan. It was not surprising there was such a strong male representation in those studies since agricultural education in the US has been a male dominated field. It was not clear why the present study's sample was skewed with females, however, it allowed for an understanding of how the sample of mostly female educators, from CTC's, with a Master's degree compared to the male dominated populations of other studies.

Educators under the age of 40 made up the largest groups of educators in the present study (67%), Agbaje et al. (49%; 2001), and Williams and Wise (64%; 1997). Not surprisingly, the mean ages of the student teachers (Watson & Halse, 2005) were younger than the educators in the literature: 1) Australia 22.2 years; 2) Indonesia 20.9 years; and 3) Maldives 20.6 years. No other studies asked whether educators taught in a high school or CTC or what region they taught in; the comparison about CTC would have been helpful to determine why more CTC educators participated in the current study.

Compared to the respondents in Agbaje et al. (2001) and Muma et al. (2010), those that made up the current sample tended to have completed more education and had taught agricultural education a fewer number of years. Seventy percent completed a Masters or Doctorate compared to 50% in Muma et al. (2010), 54% in Williams and Wise (1997), and 40% in Okeafor (2002). In addition, the respondents of the current study overall had been teaching fewer years than in Muma et al. (2010) and Agbaje et al. (2001). Perhaps a generation ago, teachers didn't need a Master's Degree to teach, hence respondents had been teaching a longer time and had less education. In comparison, in the current study, the largely younger sample needed the Master's to teach, hence the shorter teaching periods and higher levels of education.

Discussion for RQ 2: What are SBAE educators attitudes, beliefs, perceptions, and knowledge of SA?

RQ 2a: Educators' ecological paradigm as measured by the NEP. The justification for this research question was to determine what were educators' attitudes towards the environment, which was part of a larger question of whether EA affected instruction of SA and SAP. In the literature there has been division over whether or not one's attitudes and beliefs affect and could even predict their behavior, particularly in terms of SA (Beus & Dunlap, 1994b; Comer et al., 1999; Gamon et al., 1994; Hawcroft & Milfont, 2009; Salamon et al., 1997). No research had been conducted on SBAE educators' EA and how they relate to the instruction of SA and SAP in classroom teaching. The present study found that Michigan SBAE educators have mixed EA and hold a slightly eco-centric worldview (M=3.31); however, their EA did not appear to impact the self-reported importance of SAP to their instruction.

The respondents' worldview could be generalized to the Michigan SBAE educator population. Their slightly eco-centric NEP scores were anthropocentric to varying degrees compared to all three populations of international pre-service student teachers targeted by Watson and Halse (2005): 1) Australians (M=3.99); 2) Indonesians (M=3.71); and 3) Maldivians (M=3.44). Each country's group of student teachers scored significantly differently from those of the other countries (Watson & Halse, 2005). The study didn't include discussion of subscales or individual scale items, it was focused on categorizing the preservice students into categories of biospheric, egoistic, and altruistic values according to the Model of Environmental Concern. As a result, it was difficult to compare the findings of the current study to determine why the Michigan educators were more anthropocentric than all three preservice students. The researchers were attempting to determine the appropriateness of the NEP in determining EA among non-western cultures (Watson & Halse, 2005). Both the Indonesians and the Maldivian preservice students were exhibiting EA that were from an anthropomorphic and an eco-centric paradigm. Although there have been numerous studies that have used the NEP on international populations (Hawcroft & Milfont, 2009), Watson and Halse (2005) argued that the NEP may be cultural specific since it was not gathering a wide enough range of EA for those two populations.

Michigan SBAE educators also held slightly more anthropocentric worldview of the environment in comparison to the other populations in the literature. The educators held a more anthropocentric worldview than a random sample of residents in Boulder, Colorado (M=3.81; Hunter & Rinner, 2004). Hunter and Rinner (2004) residents had a range of scores, like the heterogeneity of the present study, even though overall, the mean composite score was possibly higher than other urban areas nationwide. The educators held a more anthropocentric worldview than both typical Edison customers in Detroit, Michigan and those who were voluntarily enrolled in their green-electricity program (Clark et al., 2003). Edison customers reported a mean NEP (M=3.78) compared to typical Edison customers (M=3.39). Again, despite that the Michigan SBAE educators held more anthropocentric EA than some populations of residents across the nation, they still had indicated that the SAP in the needs assessment were important to include in their instruction.

Despite holding more anthropomorphic EA on the NEP scale than the preservice student teachers, the Michigan SBAE educators still thought the SAP from the needs assessment were important to instruction. That should mean that hopefully their students have been receiving SAP instruction, at least in terms of the SAP discussed in the needs assessment. A slightly eco-centric worldview did not appear to translate into only finding SAP instruction slightly important. Muma et al. (2010) had similar findings in terms of the ACAP and instruction of SAP. Further research should be conducted to determine how the ecological paradigms of other SBAE educator populations compare to the Michigan educators. In addition, they should determine if there is a relationship between ecological paradigm and instruction of SA or SAP.

On four of the five subscales, SBAE educators formed a bimodal population, meaning they held both anthropocentric and eco-centric attitudes within the same subscale (and often within a single scale item). However, it didn't appear to matters in terms of whether educators consider SAP important for instruction. The four subscales with bimodal populations were: 1) whether a finite boundary existed to the growth of the human population, available space, and natural resources; 2) the purpose and value of nature; 3) whether humans operated outside of and were therefore exempt from the constraints of nature; and 4) the probability of the earth undergoing an ecological catastrophe. Since it was not clear why the bimodal populations emerged and they were not correlated with demographic factors, the ACAP, or the cognitive exam, further research would need to determine possible causes. In addition, in-service support for SAP instruction should take into consideration that are different EA which may require different training needs. The significant factor was that despite the bimodal populations, educators still found the SAP in the needs assessment important to include in their classroom instruction. The subscale frequencies or means cannot be compared to those of the international pres-service student teachers since Watson and Halse (2005) conducted a qualitative study.

It's not clear about the kinds of values that are being transferred to the students either, or how much that matters. While as a group educators mostly had mixed EA, overall they thought that nature was fragile. Almost all respondents shared the EA that humans must operate within the laws of nature, however, that EA was part of a subscale that had a bimodal population. Hunter and Rinner (2004) experienced similarly high results among their Boulder, Colorado residents and threw out that scale item, which raised the scale's internal reliability. That would help make sense because the other EA in the sub-scale and EA's from other sub-scales conflicted with the universal agreement to the EA that humans must operate within the laws of nature.

There were a few reasons that many of the scale items garnered up to a third of neutral responses; but most importantly was despite the neutral responses, educators still thought that all the SAP were important to instruction. Dunlap's et al. (2000) research with Washington state residents had much smaller levels of neutrality than the present study. The language could have been biased and/or perhaps educators were hesitant to commit to one worldview or another on a survey which was sourced from a respected colleague. If it was a matter of the researcher's presence, future research should address the issue to determine if a more nuanced series of responses emerges. Most importantly, even though SBAE educators were occasionally responding neutrally, they still indicated in the needs assessment that all of the SAP were important to instruction. That suggested that educator instruction of SAP did not require that educators hold a strong eco-centric worldview.

What this all meant for students was that, in terms of EA, teachers are hopefully providing SAP instruction despite the only slightly eco-cetric NEP scores, the levels of neutrality, or the bimodal populations. That bodes well for students since, at least with the Michigan educators, there was quite a lot of contention in their EA. There or may or may not be a relationships with instruction, additional research would need to be conducted to determine the ecological paradigm of other educator populations and run correlations with their EA and how important SAP are to their instruction.

RQ 2b: Educators' agricultural paradigm as measured by the ACAP. Just as with the previous research question, the justification for this one was to determine what were the educators' agricultural paradigm; which was part of a larger question of whether agricultural beliefs affected instruction of SA and SAP. In the literature there has been division over whether or not one's attitudes and beliefs affect and could even predict their behavior, particularly in terms of SA (Beus & Dunlap, 1994b; Comer et al., 1999; Gamon et al., 1994; Hawcroft & Milfont, 2009; Muma et al., 2010; Salamon et al., 1997). Udoto and Flowers (2001) argued that it was necessary for agricultural educators instructing SA to value to effectively transform student behavior and convey new knowledge. The present study was one of a few that research the agricultural beliefs of agricultural professionals.

The present study's respondents moderate alternative agricultural paradigm (M=3.79) was generalizable to the Michigan SBAE educators. The SBAE educators of the current study held a slightly more alternative agricultural worldview compared to the high school agriculture educators surveyed throughout the NCR (North Central Region), which also included Michigan educators (M=3.66; Muma et al., 2010). Michigan SBAE educators also held a more alternative worldview of agriculture than: 1) Washington State faculty (M=3.22); 2) groups of identified Washington conventional agriculturalists (M=3.05); and 3) Washington State farmers (M=3.38; (Beus & Dunlap, 1992). Not surprisingly, the self-identified Washington alternative agriculturalists held a more ecological worldview of agriculture than (M=4.25) the Michigan SBAE educators (Beus & Dunlap, 1992).

Overall, the findings in the present study were largely consistent with those from Muma et al. (2010). Of those beliefs that were included in both scales, the educators from Muma et al. (2010) believed in the following the most: 1) development of healthy soil (M=4.24); 2) that SA conserves natural resources (4.14); 3) the importance of crop rotation in SA (M=4.14); 4) SA promotes recycling of renewable resources (M=3.93); and 5) exchange of knowledge about locally designed technologies among producers promotes SAP (M=3.88). Of the beliefs that were included on both scales, those that were believed in the least were: 1) the importance of local production knowledge; 2) whether SA fosters local production marketing; 3) the role of community size in the development of agriculture; and 4) whether SA reduces the need for external inputs (Muma et al., 2010).

Interestingly, Muma et al. (2010) found the following: 1) neither educators' moderately alternative agricultural paradigm nor their moderate perceptions of SAP affected the extent they taught SAP; 2) women were significantly more likely to have higher beliefs about SA and to teach SAP to a greater extent; and 3) that there was a possible relationship between beliefs and teaching that required more research to determine what that relationship looked like.

There was very clear consistency in how the educators of the present study and those of Muma et al. (2010) rated the belief scale items; even though the means of the present study were generally higher, each competency tended to be ranked about the same for both populations. Since Michigan SBAE educators were included in the Muma et al. (2010) sample as well, what that meant was that in general SBAE educators, and those from Michigan in particular, had a consistent agricultural paradigm. They believed in an agricultural paradigm where: 1) developing healthy soils was vital and crop rotation was key that to that process; 2) it was important to conserve natural resources and recycle renewable ones for the next generations; and 3) it was important to allow for producers to disseminate information about locally designed technology amongst themselves.

In addition, they were consistent in their division about their beliefs regarding: 1) the importance of local production knowledge; 2) whether SA fosters local production marketing; 3) the role of community size in the development of agriculture; and 4) whether SA reduces the need for external inputs (Muma et al., 2010). The latter two were particularly contentious for the educators. Not only were the educators consistent in their agricultural belief, but they were also consistent across gender as well since Muma et al. (2010) consisted of mostly males. Clearly SBAE agricultural educators were consistent in not in the beliefs that they share but also consistently contentious in those that they don’t.

Since Muma et al. (2010) found that women held a more alternative agricultural paradigm than men, that could be the reason why the mean composite score and the means of the individual beliefs of the present study were consistently higher than theirs, even though the belief statements were similarly rated between studies. That may also be why all of the SAP were considered important to instruction to the educators of the present study. The present study echoes the same recommendation that additional research was warranted to determine the relationship between agricultural beliefs (Muma et al., 2010).

A strong majority from the present study believed in the 2 conventional beliefs about specialized crops and livestock (M=3.54; SD=.92) and innovations in agricultural technology (M=3.62; SD=.99). Muma et al. (2010) also included these; however, they were not considered conventional beliefs. The present study’s means were similar to those of Muma’s et al. (2010): 1)

Innovations in agricultural technology (M=3.62), and 2) SA promoted specialized crop and livestock enterprises (M=3.54). The similarity in moderate belief in both from both studies indicated that SBAE educators have a complex agricultural paradigm. Again, despite that their agricultural paradigm included beliefs from both the alternative and the conventional worldview, SBAE educators still indicated that all of the SAP were important to their instruction.

RQ 2c: Educators' knowledge of SA as measured by the SARE's "Sustainable Agriculture: Principles and Concept Overview" cognitive test. With the pressures of changing industry needs, new standards, societal changes, and changes at the university level, it was imperative to understand whether educators were prepared to instruct students about SA and SAP. The purpose of this research question was to determine what conceptual knowledge SBAE educators had of SA. The SBAE educators' overall solid grasp on the fundamental concepts of SA in the present study cannot be compared to similar populations since the existing literature has only measured knowledge of SAP rather than SA fundamentals (Udoto & Flowers, 2001; Williams, 2000; Williams & Wise, 1997). Even so, the present study provided for analysis to determine whether there were relationships between educator attitudes, beliefs, and conceptual knowledge of SA, which will be addressed later in the discussions.

In general, the educators had a fairly complete understanding of SA. However, some demonstrated sufficient gaps in their conceptual understanding, particularly regarding the economic viability of SA, which will impact their dissemination of their instruction. Educators indicated that all the SAP from the needs assessment were important to their instruction, but no correlation was run to determine if a relationship existed between that and their conceptual knowledge. However, if some educators are struggling with the bigger picture, they will be unable to provide the context in which these SAP practices exist for their students.

The students will be the ones who reap the consequences from the findings that between 20 - 30% of educators misunderstood that SA: 1) was an integrated food system that addressed issues throughout a larger system; 2) that its scope considers and balances, environmental, social, and economic factors; and 3) that SA was an approach with innumerable methods and sites where it could be implemented. Without gaining an understanding that SA operates within a greater system, agricultural students will have a narrow scope of SA and will experience difficulty implementing SA within their professions. Without recognizing that the approach involves the crucial balancing of social, economic, and environmental factors, students' professional work will gravitate toward the environmental factors like their instructors. Their actions won't be sustainable because their decision-making won't be as thoughtful as it needs to be. Without the understanding that SA was an approach that has unlimited means and places to use it, students will not know that they should or how to adapt their decision-making to multiple sites and scales. Future research should analyze the data for relationships between conceptual knowledge and the importance of SAP instruction.

RQ 2d: Educators' definitions of SA. The purpose of the research question was to determine how educators conceived of SA in their own words. Their definitions could be compared to how the literature defined their understanding of SA as captured by the conceptual cognitive exam. Again, with all the present changes, teachers need to be instructing their students in SA and SAP and we have very little information about how much they know.

The only other study to gather agricultural professionals' conceptions of SA was an outdated qualitative study that targeted Minnesota Extension Agents; however, there were some parallels with the current study (Paulson, 1995). Paulson (1995) had numerous research questions, so there wasn't extensive detail in her article about SA definitions, but a common definition was: “maintaining farm profits in the long and short run and using environmentally sound or resource-conserving practices (Paulson, 1995, p. 123).” Extension agents commonly referred to SA as involving “resource conserving practices” and half of them included reducing chemical inputs (Paulson, 1995, p. 123). Paulson’s (1995) noticed only about 20% of the extension agents specified that SA needed to be “socially acceptable.” Paulson (1995) seemed to think that the agents had a sufficient understanding of the role of the economic component; she commented that when prompted, the agents agreed with the larger economic and environmental goals of SA.

Paulson’s (1995) definitions sounded very similar to definitions from the current study in terms of the environmental component. A common definition of SA in the present study echoed Paulson’s (1995): “The ability to maintain agricultural production without degradation of resources while maintaining production levels,” (Respondent Four). In both studies, many SBAE educators and extension agents saw SA as a balance between maintaining profits or production levels as well and running an “environmentally responsible enterprise.” In the present study though, many educators had vague targets or means to obtain ecological consideration; one educator specified “by trying to reduce pollution as well as our carbon footprint.” Also, inputs were hardly discussed.

Paulson’s (1995) extension agents did a better job of including the social component; however, there were some discrepancies about the analyzing of the economic component. Paulson’s (1995) extension agents included the social component of SA twice as often that those of the present study did, where only 10% conceived of SA as a larger system of social, economic, and environmental considerations. Paulson’s only example of the economic considerations in the definitions (without prompting the agents) was the idea of “maintaining profits or production levels." The same language was used by many SBAE educators in the present study as well; however, that language has been interpreted as the educator seeing SA as something that you could "make do" using versus envisioning SA as a strong economically viable approach. No matter what, the SBAE educators had difficulty defining SA as a complete system with interrelated environmental, social, and economic prongs.

Interestingly, SBAE educators still thought all of the SAP were important to instruction, even though their definitions heavily focused on one facet of SA - the economic component and responsible resource management. Perhaps educators valued the SAP for their environmental significance, rather than the importance of their social and economic ramifications as well. The importance of stewardship over resources was apparent in their definitions, which could be how they are viewing the SAP, as ways to manage resources. In addition, they were still knowledgeable about many of the competencies from the needs assessment, but again instruction may lack a greater context of SA. Despite that the educators could recognize SA as a broader system, their ability to perhaps produce instruction that was so could be limited; students need SA instruction that is comprehensive.

SBAE educators' self-definitions compared to knowledge of SA. When the "emic" accounts of the SBAE educators' definitions were compared to the literature, the conceptual cognitive exam, a strange pattern emerged. For the most part, educators recognized a complex and inter-related SA in the cognitive exam, but when they were asked to generate their own definitions, their definitions tended to focus on just one prong of SA, the environmental component. However, the gaps in their definitions were also where a large subset of educators misunderstood SA in the exam: 1) that SA was an integrated food system that addressed issues throughout a larger system; 2) that its scope included the balancing of environmental, social, and economic factors; and 3) that SA was an approach and where the approach could be implemented. It was not clear why the unusual pattern emerged; however, it was somewhat troubling since only about 10% of educators wrote out comprehensive definitions of SA. Perhaps future use of the scale could request respondents to be more specific since their responses were vague overall.

RQ 2e: Extent relationships exist between educators' NEP, ACAP, and cognitive test scores. This research question attempted to understand whether a relationship existed between the educators EA, agricultural beliefs, and conceptual understanding of SA. Many have suggested that attitudes, beliefs, and perceptions relate to behavior and those behaviors can be predicted by constructs such as EA (Hawcroft & Milfont, 2009). Regarding perceptions of SA, secondary agricultural educators have neutral (Agbaje et al., 2001) to somewhat positive perceptions of SA (Muma et al., 2010; Williams & Wise, 1997). In addition, the instruction of SAP appears to have had limited inclusion in classroom (Agbaje, Martin, & Williams, 2001; Muma, Martin, Shelley, & Holmes, 2010; Udoto & Flowers, 2001).

Only two very weak relationships developed between the variables, the strongest of which was between EA and agricultural beliefs (.21), but neither were significant. It was not clear why stronger relationships did not emerge, however, it did not appear that the results could be generalized to the Michigan SBAE educators anyway. Further research should be conducted with the same population and others to determine if the same and/or stronger relationship emerge between EA, agricultural paradigm, and conceptual knowledge of SA.

RQ 2f: Extent relationships exist between educators' NEP score and demographics. The significance of this research question was to recognize whether any patterns existed between Michigan SBAE educators' backgrounds and their EA. Relationships between EA and demographics could help illuminate why educators hold the attitudes they do and whether those attitudes impact what they are instructing about SA. At present, correlations between NEP score and demographics among SBAE educators or others within the agricultural profession haven't been run in the literature. Watson and Halse's (2005) examination of preservice agricultural students gathered demographics as qualitative data and didn't report in their article whether they ran a qualitative analysis between NEP and demographics.

It was difficult to determine if the results could be generalized to the population, but, either way Michigan SBAE educators couldn't be differentiated by their environmental attitudes based on their demographics. A weak, positive relationship emerged between NEP and teaching region (.24), which indicated that ecological worldview was slightly different between teaching regions among the respondents, but the results were not significant. Further analysis would need to be done to determine what the NEP scores of each teaching region looked like to understand why the weak relationship emerged. It was not clear why stronger relationships did not emerge. Future research should continue to find correlations within the Michigan SBAE educator population and similar populations.

Discussion for RQ 3: What are Michigan SBAE educators' in-service needs regarding their instruction of SAP and what are their priorities?

RQ 3a: Educators' in-service needs regarding their instruction of SAP as measured by the Borich Needs Assessment Model. This research question was the first step of using the Borich Needs Assessment model to identify the gaps between Michigan SBAE educators' self-reported knowledge of certain SAP and the importance of the practices to their instruction. That allowed the researcher to rank their needs which could be addressed through avenues like in-service; that will be addressed under the next research question. The purpose of the first research question was to determine how important each competency was and how important each were to instruction since there has been very little research. The researcher dictated the parameters of the needs assessment by choosing 12 agricultural practices that have been heavily discussed in the literature, 10 of which were SAP. The two conventional agricultural practices were included to allow the researcher to compare how educators rank these needs in comparison to the SAP competencies. Including that comparison provided a more comprehensive picture of Michigan SBAE educator need for curriculum developers and in-service programmers.

Importance of competencies to instruction. Other research has found that SBAE educators teach SAP to a moderate extent in their classrooms; however the findings did not come from needs assessments (Agbaje et al., 2001; Muma et al., 2010; Okeafor, 2002). Based on a scale that ranged from 1 to 5 with 5 being to very high extent, Muma et al. (2010) determined that SBAE educators taught SAP topics to a moderate extent (M=3.16). They ran a one sample paired t-test and determined that educators were significantly more likely (at the .05 level) to have positive perceptions of the SA practices than to teach them; there was one exception which was a nitrogen application practice. In other words, educators' had slightly positive perceptions of SA, but that was not the reason that they taught SAP. The 5 topics that educators taught to the highest extent were: 1) Soil Testing (M=4.10); 2) Wildlife Conservation (M=3.77); 3) Crop Rotation (M=3.70); 4) Food Safety (M=3.64); and 5) Water Quality (M=3.57).The researchers suggested that since on 18 out of 19 practices there was only one significance difference among the means, it meant that educators conceived of the practices as similar and would probably consider other SAP not included in their study similarly. Muma et al. (2010) had the widest spread in SAP, the range in means was from 2.39 to 4.10. Their findings also supported those of

Agunda (1995) and Conner and Kolodinsky (1997) that the extent an educator reports they teach an SAP does not automatically mean they teach to that extent.

Agbaje et al. (1995) also surveyed SBAE educators in the North Central Region about the extent that they taught certain SAP; using a scale that ranged from 1 to 5 with 5 being to a Very High Extent, the mean composite NEP score was 3.59. The majority of the practices (5 out of the 8) were taught to a moderate extent. SBAE educators taught these SAP to the highest extent: 1) Soil Testing (M=4.32); 2) Soil Erosion Control (M=4.31); 3) Crop Rotation (M=3.58); and 4) Insect Resistant Crops (M=3.41; Agbaje et al., 1995). Agbaje (2001) noticed that educators were teaching topics that dealt with systems to a moderate degree and argued that the educators were not providing instruction of SAP within the context of a larger system.

Using the same 5 point scale as Agbaje (2001), Okeafor's (2002) educators had a mean composite NEP score of 3.30. The top 5 SAP taught by educators were: 1) Soil Erosion Control (M=4.06); 2) Soil Testing (M=3.89); 3) Soil Conservation (M=3.87); 4) Management of Soil Fertility (M=3.75); and 5) Water Management (M=3.55). All of the respondents indicated that they taught these SAP at least to some extent, however, Okeafor suggested that certain topics were taught more often than reduce the use of chemicals or fertilizers which had high standard deviations (SD=1.10 and SD=1.14 respectively). Okeafor (2002) also had a wide spread of mean scores ranging from 2.54 to 4.06; the lowest mean was for monocropping.

When converted to a 5 point scale, the mean composite score from the current study was M=4.04 (actual M=3.23) and considerably higher than each of the three previous studies; it was drawn from a scale from 1 to 4 with 4 being Very Important to instruction (Agbaje et al., 1995; Muma et al., 2010; Okeafor, 2002). The range in means was the smallest compared to the other studies ranging from 3.0-3.6. Of the SAP included in the present study and by the other 3 researchers, those SAP that were in at ranked the highest at least twice were: Water Quality, Crop Rotation, Soil Testing, and Soil Erosion Control. The following practices appeared at least twice as the least taught or least important to instruction: Mixed Farming, Reduced Used of Fertilizers, Use of Green Manure, and Reduced Use of Chemicals.

Muma's et al. (2010) findings about the relationship between educator importance of a SAP does not necessarily mean instruction happens in the classroom was an important point to consider (Agunda, 1995; Conner & Kolodinsky, 1997). The present study was not designed to gather data about what instructors were actually teaching in their classroom, additional research would need to find ways to do so. The present study also did not run any actual relationships between EA, agricultural paradigm, or perceptions of SA with the educators rated importance of the SAP to instruction.

That the two conventional practices were considered important too indicated that SBAE educators valued a range of agricultural practices. Muma et al. (2010) and Agbaje et al. (2001) both included insect resistant crops and herbicide resistant crops in their survey as well; although they considered them SAP. SBAE educators from Agbaje et al. (2001) taught insect resistant crops (M=3.41) and herbicide resistant crops (M=3.37) to a moderate extent and Muma et al. (2010) taught insect resistant crops (M=3.27) and herbicide resistant crops (M=3.25) to a moderate extent as well. The slight importance that SBAE educators from the present study place on their instruction of Genetically Engineered Crops (M=3.1; on a four point scale) and Pest Resistant Crops (3.2) overlapped the findings from both studies.

Knowledge of competencies. SBAE educators' knowledge of SAP ranges from limited (Williams & Wise, 1997) to moderate (Udoto & Flowers, 2001). Williams and Wise (1997) used a four point Likert-scale to measure subjects' perceived knowledge of SAP, from one to four, with 1 “I know nothing” to four being “I know a Lot.” Williams and Wise (1997) reported that educators “know some” about SAP (composite teacher mean=2.87; SD=.74). Educators knew the most about: 1) Rotational Grazing (M=3.51); 2) Row Banding of Herbicides (M=3.37); 3) Filmstrips (M=3.15); 4) Narrow Strip Intercropping (M=3.10); and 5) Fall Seeded Cover Crop (M=3.05). The two SAP that educators were the least knowledgeable about were also the only SAP that they knew only a little about: 1) Allelopathy (Cover Crop) (M=1.85) and 2) Agroforestry (M=1.90). Similar to Agbaje et al. (2001), Williams and Wise (1997) were concerned that the educators needed to have the larger picture of SA as a greater system as a context for the practices.

Udoto and Flowers (2001) asked educators to indicate their knowledge on a list of practices that included both an SAP and its goal; they obtained a composite mean score of 3.95. On a 5 point scale with 5 being Highly Informed, SBAE educators knew the most about: 1) Conservation Tillage (to reduce soil erosion and conserve water; M=4.00); 2) Crop Rotation (to reduce soil erosion; M=3.95); 3) Crop Rotation (to increase soil nitrogen; M=3.71); and 4) Scouting the field for possible weed and insect control issues (M=3.70). For 7 of the SAP, educators’ means indicated they were moderately informed; on one, they were well informed. The two that educators knew the least about were: 1) Nutrient management plan (for improving water quality; M=3.34) and 2) Animal Production Systems That Emphasize Disease Prevention (M=3.43).

The knowledge base of the present study fell closer to that of Udoto and Flowers (2001) findings since educators were on the cusp of slightly knowledgeable and knowledgeable (M=2.91). The mean was slightly misleading because on 7 out of the 12 competencies, at least 80% of educators considered themselves either knowledgeable or very knowledgeable and very few people felt they were completely unknowledgeable about a competency. It was concerning that these other studies were from 10-15 years ago and yet educators have raised their SAP knowledge only a little. Clearly in-service has a valuable role to play in supporting SBAE educator need.

The only SAP that was included across literature in which educators ranked themselves as very knowledgeable was crop rotation; the present study's mean was 3.64 when converted to a 5 point scale (actual 3.1) which was lower than Udoto and Flowers (M=3.95; 2001). Cover cropping was the only SAP in which at least 2 studies educators' rated themselves as among the least knowledgeable on; the present study's mean of 2.6 was higher than that of Williams and Wise (M=1.85; 1997).

A difference between this study and past studies is that neither Williams and Wise (1997) nor Udoto and Flowers (2001) included conventional practices in their lists. Interestingly, SBAE educators of the present study rated themselves as slightly unknowledgeable about the two conventional practices and felt that they were both important to their instruction. It should seem that educators felt much more competent teaching these competencies since they have been a part of the conventional agricultural system for some time and educators found them important to their instruction, but that wasn't the case.

RQ 3b: Prioritize educators' in-service need regarding their instruction of SAP as measured by the Borich Needs Assessment Model. The purpose of this research question was to identify from SBAE educators themselves where they needed the most support for SAP instruction. It was difficult to draw comparisons between the priorities that emerged with what existed in the literature since need assessments have not been used to for that purpose with SBAE educators. That gap in the literature was part of the justification for the present study.

Okeafor (2002) asked SBAE educators to rank their needs for in-service regarding SAP without using a needs assessment model using a 5 point Likert scale with 5 being Much Training Needed. The educators ranked the following as their highest need: 1) Insect Resistant Crops (M=3.79); 2) Herbicide Resistant Crops (M=3.77); 3) Environmental Protection (M=3.73); 4) Farming Profitability (M=3.72); and 5) Rural Culture and Preservation (M=3.38).

Boone Jr., Hersman, Boone, and Gartin (2007) conducted a needs assessment among Midwestern Extension Agents regarding SA training. The assessment was one-dimensional; it did not separate what is based on importance to profession and what is based on knowledge like the Borich Model does. On a scale of one to six, with one being strongly disagree and six being strongly agree, agents indicated their greatest needs for SA training were: 1) Economic of SA (M=4.75); 2) Innovative Farming Systems (M=4.64); 3) Marketing of SA Products (M=4.55); 4) Grazing/Forage Management (M=4.42); and 5) Farm Management Practices (M=4.37) (Boone Jr. et al., 2007).

The extension agents and SBAE educators from the present study overlapped in need regarding grazing and forage management. Extension agents and the educators from Okeafor (2002) overlapped in need for training regarding the economics of SA farming.

Since the study collected data on both knowledge and the importance of the competency to instruction, there were some nuances that in-service will want to consider for programming to maximize resources. Even though Integrated Pest Management was ranked the highest in terms of need, offering instructional support would mean that 20% of the population would be gaining a lot of knowledge on the topic while the majority (60%) would be fine-tuning their existing knowledge. Decisions would need to be made about how to account for the differing knowledge gaps without wasting resources on instructing those who already have working knowledge of the competency. That same pattern existed for Water Quality where only 11% of the respondents were slightly knowledgeable and the majority (60%) of the population's were knowledgeable and for Soil Conservation, only 13% feel slightly knowledgeable, and 66% were knowledgeable.

There was a different pattern for Management Intensive Grazing and Cover Cropping. Over 10% of educators had no knowledge of Management Intensive Grazing, almost one half (47%) were only slightly knowledgeable, and 30% were knowledgeable. However, 15% did not think it was important to classroom instruction. So in-service support should consider that while there is a lot of ground to cover in terms of training, instructional support should also include the value Management Intensive Grazing provides socially, economically, and environmentally. For Cover Cropping, 2% of SBAE educators had no knowledge, 47% had some knowledge, and 38% would be fine-tuning their knowledge. However, a tenth (11%) of the educators didn't think it was important to their classroom instruction, which could be the reason that there were such high frequencies of those who were only slightly knowledgeable. Again, part of the instructional support would need to be a demonstration on the value of Cover Cropping.

Recommendations

1. In-service and curriculum development specialists in Michigan may want to wait for additional research to be conducted on state SBAE educators' needs since the results were not generalizable.
2. Since the NEP results did represent the Michigan SBAE educators, any support in-service provides for SBAE educators in the future should consider how to better serve an educator population with mostly heterogeneous EA.

3. Muma suggested that since women significantly are more likely to have higher ACAP beliefs and teach SAP to a greater extent, in-service should also consider again how to account for supporting differing needs.
4. If additional research indicates a similar list of prioritized needs for in-service, those designing the programming should consider how to best utilize limited time and resources by determining which of the top 5 to instruct and how. Some of the SAP, like Management Intensive Grazing, a majority of educators have working knowledge of and only small percentage have minimal knowledge.
5. If and when in-service addresses Michigan SBAE educators prioritized list of needs, training should provide context for the SAP instruction: that SA is an approach, that SA operates within a larger system, and value and importance of the social and economic components of the system.

Recommendations for Further Study

1. Researchers should conduct the survey again with Michigan SBAE educators.
2. Conduct the survey with other SBAE educator populations to draw comparisons concerning their EA, agricultural beliefs, perceptions, conceptual knowledge of SA, and their prioritized needs.
3. Modify the scale to remove the neutral response option in the NEP to obtain a more nuanced NEP score and throw out the NEP scale item “Despite our special abilities, humans are still subject to the laws of nature.”
4. Consider additional quantitative scale items: to what extent do I teach SAP and to what extent do I teach SA. Run correlations with EA, agricultural beliefs, and conceptual knowledge of SA.

5. See if correlations between EA, agricultural beliefs, and conceptual knowledge emerge with new samples. Run correlations between the importance of SAP to instruction and all of these.
6. It's hard to know which is a more accurate picture of the educators' conceptual knowledge of SA – the definition or the cognitive exam. Use both again, but make the qualitative prompt very specific: "What is SA? What are its goals? What are ways it can achieve them? Please be specific."
7. Target Michigan agricultural students to determine their EA, agricultural beliefs, and conceptual knowledge of SA. Perhaps target recent high school graduates with agricultural backgrounds and include a needs assessment to determine how prepared they feel for college or their profession. The results could be useful for in-service as well.
8. As Muma et al. (2010) recommended, conduct additional research to determine the exact relationship between attitudes and behavior in terms of SA and SAP instruction.

APPENDICES

APPENDIX A

ONLINE SURVEY CONSENT FORM

This is an invitation to participate in a voluntary research survey, which you are receiving as an agriscience, food, and natural resources teacher (AFNR) in Michigan. Again, this needs assessment is being conducted by Rebecca Wittman through Michigan State University under the supervision of Matt Raven. Your input is important to help us determine in-service needs regarding sustainable agriculture and related topics. The survey will take between 10-20 minutes to complete. All participants who complete the survey will be entered into a random raffle to receive one of THREE $50 Amazon.com gift cards. Since participation in this research is completely voluntary, you have the right to say no, choose not to answer specific questions or opt out at any time during the survey; there will be no consequences for any of these actions. All responses are confidential and solely for research purposes of the Michigan State University Department of Community, Agriculture, Recreation, and Resources Studies. All survey responses will be analyzed collectively. Consequently, the presentation of these collective results prevents responses from being attributed to individuals. If you have any questions or concerns about any part of this study, please contact Rebecca Wittman at wittmanr@msu.edu or by mail:

Rebecca Wittman
Natural Resources
480 Wilson Road Room 310
East Lansing, MI 48824

If you have any questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-432-4503 or email irb@msu.edu or regular mail at:

207 Olds Hall
Michigan State University
East Lansing, MI 48824

If you would like to receive a summary of the survey results, please contact Rebecca Wittman at wittmanr@msu.edu. Submission of the on-line survey means that you voluntarily agree to participate in this research study.

APPENDIX B

ONLINE SURVEY

1) How do you define sustainability in AGRICULTURE (Please be as specific as possible)?

For the following series of questions, please select one choice for each statement.

Please indicate to what extent you AGREE with the following BELIEF statements about sustainable agriculture (Please select one response for each question):

	Please indicate to what extent you AGREE with the following statements:	SD	D	N	A	SA
1	Development of healthy soils is important for SA					
2	SA conserves natural resources for the benefit of future generations					
3	Crop rotation is important to achieving SA					
4	SA promotes recycling of renewable natural resources					
5	Exchange of knowledge about locally designed technologies among producers promotes SAP					
6	Integrating diverse crops with livestock enterprises promotes SA					
7	Local farming practice impacts success of SA					
8	The size of a community impacts development of SA					
9	SA promotes local processing of agricultural production					
10	Local knowledge of farming in a community is an indication of sustainability in agriculture					
11	SA reduces need for external sources of inputs					
12	SA promotes local marketing of agricultural production					
13	SA promotes specialized crop and livestock enterprises					
14	Innovations in agricultural technology determine the success of SA					

SD=Strongly Disagree; D=Disagree; N=Neutral; A=Agree; SA=Strongly Agree

For the following series of questions, please select one choice for each statement.

Based on your own ATTITUDES, please indicate to what extent you AGREE with the following statements (Please select one response for each question):

	Please indicate to what extent you AGREE with the following statements:	SD	D	N	A	SA
1	We are approaching the limit of the number of people that the earth can support.					
2	Humans have the right to modify the natural environment to suit their needs.					
3	When humans interfere with nature, it often produces disastrous consequences.					
4	Human ingenuity will ensure that we do not make the earth unlivable.					
5	Humans are severely abusing the environment.					
6	The earth has plenty of natural resources if we just learn how to develop them.					
7	Plants and animals have as much right as humans to exist.					
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations.					
9	Despite our special abilities, humans are still subject to the laws of nature.					
10	The so-called "ecological crisis" facing humankind has been greatly exaggerated.					
11	The earth is like a spaceship with very limited room and resources.					
12	Humans were meant to rule over the rest of nature.					
13	The balance of nature is very delicate and easily upset.					
14	Humans will eventually learn enough about how nature works to be able to control it.					
15	If things continue on their present course, we will soon experience a major ecological catastrophe.					

SD=Strongly Disagree; D=Disagree; N=Neutral; A=Agree; SA=Strongly Agree

In the CENTER column below is a list of agricultural concepts and skills. For each item listed in this column, please indicate TWO things:

First, rate how IMPORTANT teaching that concept or skill is to you in your classroom instruction (Select an answer from the LEFT column). Second, rate how KNOWLEDGEABLE you are in that concept or skill (Select an answer from the RIGHT column).

Very Unimportant	Unimportant	Important	Very Important	Competency	Unknowledgeable	Slightly Knowledgeable	Knowledgeable	Very Knowledgeable
				Composting				
				Cover Cropping				
				Crop Rotation				
				Genetically Engineered Crops				
				Integrated Pest Management				
				Management Intensive Grazing				
				Mixed Farming				
				Nitrogen Cycle				
				Pest Resistant Crops				
				Reduced Tillage				
				Soil Conservation				
				Water Quality				

The following few questions seek your knowledge of sustainability in agriculture.

43 Which of the following is TRUE (Please select one)?
- ❍ Sustainable agriculture is the same thing as organic farming
- ❍ Farmers should focus primarily on taking care of the environment
- ❍ Farms and ranches need to be profitable to be sustainable
- ❍ Farmers should all try to direct market their products

44 Which of the following is TRUE (Please select one)?
- ❍ Science based information is more valuable than the local, experience-based information from farmers and ranchers
- ❍ The site specific nature of sustainable agriculture makes farmer knowledge and experience critical to long term success
- ❍ Farmers should NOT rely on scientific information to help achieve sustainability
- ❍ Extension providers should talk to farmers about sustainability, but their real source of information is the land grant university

45 Which of the following is TRUE (Please select one)?
- ❍ Sustainable agriculture involves developing new methods that protect farm resources while maintaining economic viability
- ❍ Diversification of crops and livestock can reduce the negative environmental impacts of agriculture, but will reduce profitability
- ❍ Using a set of prescribed practices over time can reduce the negative environmental impacts of agriculture
- ❍ Few skills are needed for the successful interaction of Extension personnel with local farmers

46 Which of the following is TRUE (Please select one)?
- ❍ Many different kinds of farms can be sustainable
- ❍ The main role of farmers and ranchers is as environmental stewards
- ❍ Sustainable agriculture requires that NO agricultural chemicals be used in the production of food crops
- ❍ The main goal of sustainable agriculture is to eliminate the use of pesticides

47 Which of the following is TRUE (Please select one)?
- ❍ Stewardship of natural resources is critical to sustainable agriculture
- ❍ Only small farms can be sustainable
- ❍ Profitability is the main indicator of sustainability
- ❍ The only sustainable farms are organic farms

48 Which of the following is TRUE (Please select one)?
- ❍ Sustainable agriculture focuses almost completely on production problems
- ❍ For a farm to be sustainable, the farmer has to be willing to accept reduced profitability
- ❍ The different components of the agricultural system, like production and marketing, affect each other
- ❍ A focus on marketing is the best way to achieve sustainability

49 Which of the following is TRUE (Please select one)?
- ❍ The application of science outweighs the value of experiential knowledge in creating sustainable farming systems
- ❍ The transition to sustainable agriculture can be implemented quickly and easily
- ❍ The transition to sustainable agriculture is a long-term, dynamic process
- ❍ Sustainable agriculture depends largely on more government programs

50 Which of the following is TRUE (Please select one)?
- ❍ Improving the quality of life of farmers and ranchers is of minor importance
- ❍ Sustainable agriculture is the same thing as organic farming
- ❍ Farms and ranches need to be both profitable and environmentally sound
- ❍ Farmers should focus primarily on taking care of the environment

51 Which of the following is TRUE (Please select one)?
- ❍ Sustainable agriculture is producer-centered, but it encompasses issues related to the whole food system
- ❍ The single most important goal of a community based food system is to improve the living conditions of the farm laborer
- ❍ Community based food systems play a minor role in sustainable agriculture
- ❍ Sustainable agriculture is mostly environmentally oriented

For the following series of questions, please select one answer for each question.

52 What is your GENDER?
- ❍ Female
- ❍ Male

53 What year were you BORN?

54 What is your HIGHEST degree completed?
- ❍ Bachelor's
- ❍ Master's
- ❍ Doctorate
- ❍ Other (Please Specify): ____________________

55 How many YEARS have you taught school based agriscience, food, and natural resource education?
- ❍ 0 - 5 years
- ❍ 6 - 10 years
- ❍ 11 - 15 years
- ❍ 16 - 20 years
- ❍ 21 - 25 years
- ❍ 26 years or more

56 What REGION are you currently an agriscience, food, and natural resources educator in?
- ❍ Region 1
- ❍ Region 2
- ❍ Region 3
- ❍ Region 4
- ❍ Region 5
- ❍ Region 6

57 What SETTING do you primary teach in?
- ❍ Comprehensive 4-year high school
- ❍ Career Tech Center

If you have any further feedback to contribute that wasn't addressed earlier in this survey, please use the space below to do so.

Thank you for your time and feedback! Again, if you have any questions, please contact Rebecca Wittman at wittmanr@msu.edu.

APPENDIX C

SURVEY INVITATION

Dear Dr./Mr./Ms. Respondent's Last Name,

You are invited to participate in a research study about your views regarding sustainable agriculture. Your input as a Michigan Agriculture, Food and Natural Resource (AFNR) teacher is important to help us determine in-service needs regarding sustainable agriculture and related topics. This needs assessment is being conducted by Rebecca Wittman through Michigan State University under the supervision of Matt Raven.

There are no known risks if you decide to participate in this research study, neither are there any costs for participating in this study. The information you provide will help us determine how educators perceive sustainable agriculture to provide better in-service regarding sustainability instruction. Your participation in this study is voluntary and will directly impact future curriculum development and in-service.

Participants who complete the survey will be entered into a raffle from which 3 individuals will be randomly selected to receive a $50 Amazon.com gift card. The responses of this survey will remain completely confidential and all responses will be aggregated for analysis. If you have questions, please email Rebecca Wittman at wittmanr@msu.edu.

Follow this link to the Survey:

Or copy and paste the URL below into your Internet browser:

Thank you for your time,

Rebecca Wittman, Graduate Student
Department of Community, Agriculture, Recreation, and Resource Studies

Matt R. Raven
Professor of Agriculture, Food, and Natural Resource Education

APPENDIX D

ONLINE SURVEY REMINDERS

Reminder 1

Dear Dr./Mr./Ms. Respondent's Last Name,

Recently you were invited to participate in a survey about sustainable agriculture. The survey seeks your views as a Michigan Agriculture, Food, and Natural Resource (AFNR) teacher about sustainable agriculture and related topics. Obtaining your input is incredibly important to ensure that the results portray an adequate and authentic picture of the state. These results will be used to help develop in-service and curriculum to benefit you and your program. This needs assessment is being conducted by Rebecca Wittman as her master's thesis in the Department of Community, Agriculture, Recreation, and Resource Studies at Michigan State University.

Your participation in the study is voluntary. The responses of this survey will remain completely confidential and all responses will be aggregated for analysis.

Those who complete the survey will be entered into a raffle from which 3 individuals will be randomly selected to receive a $50 Amazon.com gift card. Your chances of being selected are better than 1 in 30, much better odds than for those of you who recently purchased lottery tickets! If you have questions, please email Rebecca Wittman at wittmanr@msu.edu.

Follow this link to the Survey:

Or copy and paste the URL below into your internet browser:

Follow the link to opt out of future emails:

Thank you for your time,

Randy Showerman
Michigan Department of Education
Director of Institute of Agricultural Technology
College of Agriculture and Natural Resources
Michigan State University
Advisor of Michigan FFA Association

Reminder 2

Dear Dr./Mr./Ms. Respondent's Last Name,

Last month, I emailed you an invitation to participate in a survey about your views on sustainable agriculture and other topics. I am conducting a teacher-reported needs assessment of Michigan agriscience instruction for my master's thesis in the Department of Community, Agriculture, Recreation, and Resource Studies at Michigan State University. To the best of my knowledge, your survey has not yet been completed.

I am writing again because of the importance that your survey response will have in helping communicate your OWN NEEDS regarding your classroom instruction. It is only by receiving input from each Agriculture, Food, and Natural Resource teacher in Michigan that I can be sure these results provide an accurate picture of agriscience instruction in Michigan. These results will be used to help develop in-service and curriculum to benefit you and your program. Participation in the survey is completely voluntary and completion will take between 11-15 minutes.

Participants who complete the survey will be entered into a raffle from which THREE individuals will be randomly selected to receive a $50 Amazon.com gift card.

The responses of this survey will remain completely confidential. All identifiers to your response will be removed before the data is analyzed.

I hope that you find this survey allows you to adequately communicate your current needs regarding your instruction. If you have questions, please email Rebecca Wittman at wittmanr@msu.edu.

Follow this link to the Survey:

Or copy and paste the URL below into your internet browser:

Follow the link to opt out of future emails:

Thank you for your time,

Rebecca Wittman, Graduate Student
Department of Community, Agriculture, Recreation, and Resource Studies

Matt R. Raven
Professor of Agriculture, Food, and Natural Resource Education

Reminder 3

Dear Dr./Mr./Ms. Respondent's Last Name,

Several weeks ago, I emailed you an invitation to participate in a survey about your views on sustainable agriculture and other topics. I am conducting a teacher-reported needs assessment of Michigan agriscience instruction for my master's thesis in the Department of Community, Agriculture, Recreation, and Resource Studies at Michigan State University. I am writing again because, to the best of my knowledge, your survey has not yet been completed.

Your participation is extremely significant. This survey is very timely with secondary Agriscience, Food, and Natural Resource education being impacted by both the National AFNR Career Cluster Content Standards and the Common Career Technical Standards. Both sets of standards identify sustainable agricultural and/or green standards as an existing need within the Agriculture and Natural Resource industry. I'm attempting to understand that in response to these changes, what your thoughts are.

Participation in the survey is completely voluntary and completion will take between 10-20 minutes.

Participants who complete the survey will be entered into a raffle from which THREE individuals will be randomly selected to receive a $50 Amazon.com gift card.

The responses of this survey will remain completely confidential. All identifiers to your response will be removed before the data is analyzed.

I hope that you find this survey allows you to adequately communicate your current needs regarding your instruction. If you have questions, please email Rebecca Wittman at wittmanr@msu.edu.

Follow this link to the Survey:

Or copy and paste the URL below into your internet browser:

Follow the link to opt out of future emails:

Thank you for your time,

Rebecca Wittman, Graduate Student
Department of Community, Agriculture, Recreation, and Resource Studies

Matt R. Raven
Professor of Agriculture, Food, and Natural Resource Education

APPENDIX E

ONLINE SURVEY THANK YOU

Dear Dr./Mr./Ms. Respondent’s Last Name,

A few months ago, you generously participated in the research I'm conducting for my master's thesis at MSU in the Department of Community, Agriculture, Recreation, and Resource Studies. I appreciate your time and support in taking the survey, which was a self-reported needs assessment among Michigan school based agriscience, food, and natural resource educators. Your timely input will directly benefit you and your program by informing curriculum development and in-service regarding sustainability instruction.

As a participant of the survey, you have been entered into a raffle from which 3 names will be selected randomly to receive a $50 Amazon.com gift card. I will contact those who will receive the gift cards via email.

If you have any questions about the study, please email to wittmanr@msu.edu.

Thank you for your time,

Rebecca Wittman, Graduate Student
Department of Community, Agriculture, Recreation, and Resource Studies

Matt R. Raven
Professor of Agriculture, Food, and Natural Resource Education

APPENDIX F

PHONE DATA COLLECTION CONSENT FORM

Since participation in this research is completely voluntary, you have the right to say no, choose not to answer specific questions or opt out at any time during the survey; there will be no consequences for any of these actions.

All responses are confidential and solely for research purposes of the Michigan State University Department of Community, Agriculture, Recreation, and Resources Studies. All survey responses will be analyzed collectively.

If you have any questions or concerns about any part of this study, please contact Rebecca Wittman at wittmanr@msu.edu or by mail:

Rebecca Wittman
Natural Resources
480 Wilson Road Room 310
East Lansing, MI 48824

If you have any questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-432-4503 or email irb@msu.edu or regular mail at:

207 Olds Hall
Michigan State University
East Lansing, MI 48824

If you would like to receive a summary of the survey results, please contact Rebecca Wittman at wittmanr@msu.edu.

APPENDIX G

PHONE DATA COLLECTION

For the following series of questions, please select one choice for each statement.

Please indicate to what extent you AGREE with the following BELIEF statements about sustainable agriculture (Please select one response for each question):

	Please indicate to what extent you AGREE with the following statements:	SD	D	N	A	SA
1	Development of healthy soils is important for SA					
2	SA conserves natural resources for the benefit of future generations					
3	Crop rotation is important to achieving SA					
4	SA promotes recycling of renewable natural resources					
5	Exchange of knowledge about locally designed technologies among producers promotes SAP					
6	Integrating diverse crops with livestock enterprises promotes SA					
7	Local farming practice impacts success of SA					
8	The size of a community impacts development of SA					
9	SA promotes local processing of agricultural production					
10	Local knowledge of farming in a community is an indication of sustainability in agriculture					
11	SA reduces need for external sources of inputs					
12	SA promotes local marketing of agricultural production					
13	SA promotes specialized crop and livestock enterprises					
14	Innovations in agricultural technology determine the success of SA					

SD=Strongly Disagree; D=Disagree; N=Neutral; A=Agree; SA=Strongly Agree

For the following series of questions, please select one choice for each statement.

Based on your own ATTITUDES, please indicate to what extent you AGREE with the following statements (Please select one response for each question):

	Please indicate to what extent you AGREE with the following statements:	SD	D	N	A	SA
1	We are approaching the limit of the number of people that the earth can support.					
2	Humans have the right to modify the natural environment to suit their needs.					
3	When humans interfere with nature, it often produces disastrous consequences.					
4	Human ingenuity will ensure that we do not make the earth unlivable.					
5	Humans are severely abusing the environment.					
6	The earth has plenty of natural resources if we just learn how to develop them.					
7	Plants and animals have as much right as humans to exist.					
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations.					
9	Despite our special abilities, humans are still subject to the laws of nature.					
10	The so-called "ecological crisis" facing humankind has been greatly exaggerated.					
11	The earth is like a spaceship with very limited room and resources.					
12	Humans were meant to rule over the rest of nature.					
13	The balance of nature is very delicate and easily upset.					
14	Humans will eventually learn enough about how nature works to be able to control it.					
15	If things continue on their present course, we will soon experience a major ecological catastrophe.					

SD=Strongly Disagree; D=Disagree; N=Neutral; A=Agree; SA=Strongly Agree

If you have any further feedback to contribute that wasn't addressed earlier in this survey, please use the space below to do so.

Thank you for your time and feedback! Again, if you have any questions, please contact Rebecca Wittman at wittmanr@msu.edu.

APPENDIX H

PHONE DATA PARTICIPATION INVITATION

Hi Dr./Mr./Ms. Respondent's Last Name, I'm Rebecca Wittman, I'm a Master's student enrolled in the Department of Community, Agriculture, Recreation, and Resource Studies at Michigan State University. How are you doing today? I have a question for you and I was wondering if I could have a couple minutes of your time?

If no: That's just fine. I'd still love the chance to speak with you, is there a more convenient time this week that I can reach you? Should I use the same number?

I am calling you about my master's thesis, which I am carrying outunder the supervision of Matt Raven. For my thesis, I'm conducting a teacher-reported needs assessment of Michigan's school-based agriscience instruction. You might remember seeing emails from me over the past few months inviting you to participate in a survey about your views on sustainable agriculture and other topics. At this point, the survey has been closed and the data been collected.

However, since the results of this study will inform in-service, it's vital to identify the extent that the responses I've received accurately represent the views of agriscience educators throughout Michigan. So I am contacting you and other educators who didn't respond to the original survey to invite you to participate in a brief 4-6 minute survey over the phone.The responses of this shortened survey are simply to help me gauge if there is a difference between those who responded to the original survey and those who did not. Does this make sense?

If you choose to participate, I would ask you a few questions over the phone from the original survey. Your responses would be kept confidential and again, your responses would not be reported as part of the results. Do you have any questions?

Would you like to participate, and if so, is this a good time?

APPENDIX I

PHONE DATA COLLECTION FOLLOW UP

Dear Ms./Dr./Mr. Respondent's Last Name,

A few months ago, you generously participated in the research I'm conducting for my master's thesis at MSU in the Department of Community, Agriculture, Recreation, and Resource Studies. I am emailing you for two reasons. I absolutely appreciate your time and support in speaking with me over the phone and answering a few survey questions! I'm also providing you with contact information in case you have any questions or concerns about my research or about your role as a research participant.

The research I'm conducting is a self-reported needs assessment among Michigan school based agriscience, food, and natural resource educators. Earlier in the year, I invited all Michigan school based agriscience, food, and natural resource educators to participate in this survey on sustainable agriculture and other topics.

Your participation over the phone in a shortened survey assisted me in identifying the extent that the responses I had received to the full survey accurately represented the views of all agriscience educators throughout Michigan. With that information, the study's results will directly benefit you and your program by informing curriculum development and in-service regarding sustainability instruction.

If you have any questions or concerns about any part of this study, or would like to receive a summary of the survey results, please contact Rebecca Wittman at wittmanr@msu.edu or by mail:

Rebecca Wittman
Natural Resources
480 Wilson Road Room 310
East Lansing, MI 48824

If you have any questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-432-4503 or email irb@msu.edu or regular mail at:

207 Olds Hall
Michigan State University
East Lansing, MI 48824

Thank you again for your participation!

Rebecca Wittman, Graduate Student
Department of Community, Agriculture, Recreation, and Resource Studies

Matt R. Raven
Professor of Agriculture, Food, and Natural Resource Education

REFERENCES

REFERENCES

Agbaje, K., Martin, R., & Williams, D. (2001). Impact of sustainable agriculture on secondary school agricultural education teachers and programs in the North Central region. *Journal of Agricultural Education, 42*(2), 38-45.

Agunda, R. (1995). What Ohio extension agents say about sustainable agriculture. *Journal of Sustainable Agriculture, 5*(3), 169-187.

Allen, J. C., & Bernhardt, K. (1995).Farming practices and adherence to an alternative-conventional agricultural paradigm. *Rural Sociology, 60*(2), 297-309.

Alonge, A. J., & Martin, R. A. (1995). Assessment of the adoption of sustainable agriculture practices: Implications for agriculture education. *Journal of Agricultural Education, 3*(3), 34-42.

Barrick, R. K., Ladewig, H. W., & Hedges, L. E. (1983). Development of a systematic approach to identify technical in-service needs of teachers. *Journal of the American Association of Teacher Educators in Agriculture, 24*(1), 13–19.

Bethlehem, J., Cobben, F., & Schouten, B. (2011).*Handbook of nonresponse in household surveys.* Hoboken, NJ: John Wiley & Sons, Inc.

Beus, C. E., & Dunlap, R. E. (1990). Conventional versus alternative agriculture: The paradigmatic roots of the debate. *Rural Sociology, 55*(4), 590-616.

Beus, C. E., & Dunlap, R. E. (1991). Measuring adherence to alternative vs. conventional agricultural paradigms: A proposed scale. *Rural Sociology, 56*(3), 432-460.

Beus, C. E., and Dunlap, R. E. (1992). The alternative-conventional agriculture debate: Where do agricultural faculty stand? *Rural Sociology, 57*(3), 363-380.

Beus, C. E., & Dunlap, R. E. (1993). Agricultural policy debates: examining the alternative and conventional perspectives. *American Journal of Alternative Agriculture, 58*(3), 98-106.

Beus, C. E., & Dunlap, R. E. (1994a).Agricultural paradigms and the practice of agriculture. *Rural Sociology, 59*(4), 620-635.

Beus, C. E., & Dunlap, R. E. (1994b).Endorsement of agrarian ideology and adherence to agricultural paradigms. *Rural Sociology, 59*(3), 462-484.

Boone Jr., H. N., Hersman, E. M., Boone, D. A., & Gartin, S. A. (2007). Knowledge of sustainable agricultural practices by extension agents in Ohio, Pennsylvania, and West Virginia. *The Journal of Extension, 45*(5), 5RIB2.

Borich, G. D. (1980). A needs assessment model for conducting follow-up studies. *The Journal of Teacher Education, 31*(3), 39-42.

Borsari, B., Vidrine, M. F., & Doherty, S. (2002). Assessing students' preparedness towards sustainability in US and European undergraduate agricultural curricula. *American Journal of Alternative Agriculture, 17*(4), 188-194.

Carl D. Perkins Career and Technical Education Improvement Act, 120 U.S.C. § 683 (2006).

Chiappe, M. B., & Flora, C. B. (1998). Gendered elements of the alternative agriculture paradigm. *Rural Sociology, 63*(3), 372-393.

Clark, C. F., Kotchen, M. J., & Moore, M. R. (2003). Internal and external influences on pro–environmental behavior: Participation in a green electricity program. *Journal of Environmental Psychology, 23,* 237–246.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159.

Colasanti, K., Cantrell, P., Cocciarelli, S., Collier, A., Edison, T., Doss, J., George, V., Hamm, M., Lewis, R., Matts, C., McClendon, B., Rabaut, C., Schmidt, S., Satchell, I., Scott, A., & Smalley, S. (2010). *Michigan Good Food Charter.* East Lansing, MI: C.S. Mott Group for Sustainable Food Systems at Michigan State University, Food Bank Council of Michigan, Michigan Food Policy Council.

Comer, S., Ekanem, E., Muhammad, S., Singh, S. P., & Tegegne, F. (1999). Sustainable and conventional farmers: A comparison of socio-economic characteristics, attitude, and beliefs. *Journal of Sustainable Agriculture, 15*(1), 29-45.

Conner, D., and Kolodinsky, J. (1997). Can you teach an old dog new tricks? An evaluation of extension training in sustainable agriculture, *Journal of Sustainable Agriculture, 10*(4), 5-20.

CTE At-a-Glance. (n.d.). Retrieved February 3, 2013, from: http://www.careertech.org/career-technical-education/

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2009). *Internet, mail, and mixed-mode surveys: The tailored design method.* Hoboken, NJ: John Wiley and Sons, Inc.

Duncan, D. W., & Ricketts, J. C. (2008). Total program efficacy: A comparison of traditional and alternatively certified agriculture teachers. *Journal of Agricultural Education 49*(4), 38–46.

Dunlap, R. E. (2008). The new environmental paradigm scale: From marginality to worldwide use. *The Journal of Environmental Education, 40*(1), 3-18.

Dunlap, R. E., Beus, C. E., Howell, R. E., & Waud, J. (1992). What is sustainable agriculture? An empirical examination of faculty and farmer definitions. *Journal of Sustainable Agriculture, 3*(1), 5-39.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425-442.

Dunlap, R. E., & Van Liere, K. D. (1978). The “New environmental paradigm.” *Journal of Environmental Education, 9*(4), 10-19.

Esters, L. (2007).Factors influencing postsecondary education enrollment behaviors of urban agricultural education students. *Career and Technical Education Research, 32*(2), 79-98.

Evolution of Career Clusters knowledge and skills and the Common Career Technical Core [PowerPoint slides]. (n.d.). Retrieved from the Career Technical Education(CTE) website: http://www.careertech.org/resources/webinars.html

Gable, R. K., Pecheone, R. L., & Gillung, T. B. (1981). A needs assessment model for establishing personnel training priorities. *Teacher Education and Special Education, 4*(4), 8-14.

Gamon, J., Harrold, N., & Creswell, J. (1994). Educational delivery methods to encourage adoption of sustainable agricultural practices. *Journal of Agricultural Education, 35*(1), 38–42.

Garton, B. L. & Chung, N. (1996). The in-service needs of beginning teachers of agriculture as perceived by beginning teachers, teacher educators, and state supervisors. *Journal of Agricultural Education, 37*(3), 52-58.

Garton, B. L., & Chung, N. (1997). An assessment of the in-service needs of beginning teachers of agriculture using two assessment models. *Journal of Agricultural Education, 38*(3), 51–58.

Hansen, M. H., & Hurwitz, W.H. (1946). The problem of nonresponse in sample surveys. *Journal of the American Statistical Association, 41*, 517–529.

Hawcroft, L. J., & Milfont, T. L. (2009). The use (and abuse) of the new environmental paradigm scale over the last 30 years: A meta-analysis. *Journal of Environmental Psychology, 30*(1), 143-158.

Hunter, L. M., & Rinner, L. (2004). The association between environmental perspective and knowledge and concern with species diversity. *Society & Natural Resources, 17*(1), 517–532.

Jackson-Smith, D. B., & Buttel, F. H. (2003). Social and ecological dimensions of the alternative-conventional agricultural paradigm scale. *Rural Sociology, 68*(4), 513- 530.

Joerger, R. M. (2002). A comparison of the in-service education needs of two cohorts of beginning Minnesota agricultural education teachers. *Journal of Agricultural Education, 43*(3), 11–24.

Kortenkamp, K. V., & Moore, C. F. (2006). Time, uncertainty, and individual differences in decisions to cooperate in resource dilemmas. *Personality and Social Psychology Bulletin, 32*(5)*,* 603–615.

Knorr, D., & Watkins, T. R. (Eds.). (1984). *Alterations in Food Production.* New York, NY: Van Nostrand Reinhold.

Knudson, W. A., & Peterson, H. C. (2012).*The strategic marketing institute working paper: The economic impact of Michigan's food and agriculture system* (Report No. 01-0312). East Lansing, MI: Michigan State University Product Center.

Layfield, K. D., & Dobbins, T. R. (2002). In-service needs and perceived competencies of South Carolina agricultural educators. *Journal of Agricultural Education, 43*(4), 46–55.

Maloney, M. P., Ward, M. P., & Braucht, G. N. (1975). Psychology in action: A revised scale for the measurement of ecological attitudes and knowledge. *American Psychologist, 30*(7), 787–790.

MacRae, J. R., Henning, J., & Hill, S. B. (1993). Strategies to overcome barriers to the development of sustainable agriculture in Canada: The role of agri-business. *Journal of Agricultural and Environmental Education Ethics 6*(1), 21–51.

Marshall, T. A., & Herring, D. R. (1991). Sustainable agriculture: An essential part of the in-agriculture curriculum. *The Agricultural Education Magazine, 64*(1), 10-21.

McCallister, D. L., Lee, D. J., & Mason, S. C. (2005). Student numbers in agronomy and crop science in the United States: History, current status, and possible actions. *NACTA Journal, 49*(3), 24-29.

Milfont, T. L. (2007).*Psychology of environmental attitudes: A cross-cultural study of their content and structure.* (Unpublished doctoral dissertation). University of Auckland, Auckland, New Zealand.

Milfont, T. L., & Duckitt, J. (2010). The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology, 30*(1), 80-94.

Muma, M., Martin, R., Shelley, M., & Holmes Jr., L. (2010). Sustainable agriculture: Teacher beliefs and topics taught. *Journal of Sustainable Agriculture, 34*(4), 439-459.

Myers, B. E., Breja, L. M., & Dyer, J. E. (2004). Recruitment issues of high school agricultural education programs. *Journal of Agricultural Education, 45*(4), 12-21.

Nagel, J. C. (2012, April 13). Michigan agricultural powers through recession unfazed. *AgriNotes & News.* Retrieved from http://www.michfb.com/agrinotes/index/284/2464

National Association of State Directors of Career Technical Education Consortium/National Career Technical Education Foundation. (2012). *Common Career Technical Core.* Silver Spring, MD.

National Council for Agricultural Education (NCAE) (2009).*National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards.* Alexandria, VA: National FFA Foundation.

National Research Council (NRC). (2009). *Transforming agricultural education for a changing world.* Washington, DC: The National Academies Press.

Newman, M. E., & Johnson, D. M. (1994). In-service education needs of teachers of pilot agriscience courses in Mississippi. *Journal of Agricultural Education, 35*(1), 54–60.

Okeafor, E. C. (2002).*Secondary school teachers' perceptions regarding the process of teaching sustainable agriculture in the agriculture education curriculum.* (Unpublished doctoral dissertation). Iowa State University, Ames.

Paulson, D. (1995). Minnesota extension agents' knowledge and views of alternative agriculture. *American Journal of Alternative Agriculture, 10*(3), 122-128.

Pirages, D. C., & Ehrlich, R. R. (1974).*Ark II: Social response to environmental imperatives.* San Francisco, CA: W. H. Freeman.

Rideout, B. E., Hushen, K., McGinty, D., Perkins, S., & Tate, J. (2005). Endorsement of the new ecological paradigm in systematic and email samples of college students. *The Journal of Environmental Education, 36*(2), 15-23.

Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data* (2nd ed.). New York, NY: Sage Publications.

Russell, E. B. (1993). Attracting youth to agriculture: How colleges of agriculture can expand their role. *Journal of Extension, 31*(4), 13-14.

S.Res. 624, 101st Cong., 104 Stat. 3359 (1990) (enacted).

Salamon, S., Farnsworth, R. L., Bullock, D. G., & Yusuf, R. (1997).Family factors affecting adoption of sustainable farming systems. *Journal of Soil and Water Conservation, 52*(4), 265–277.

Sorensen, T., Tarpley, R. S., & Warnick, B. K. (2010). In-service needs of Utah agriculture teachers. *Journal of Agricultural Education, 51*(3), 1–11.

Udoto, M., & Flowers, J. (2001, December).*Perceptions of agricultural education teachers toward sustainable agriculture practices.* Paper presented at the 28th Annual National Education Research Conference, New Orleans, LA. Retrieved from http://eric.edu.gov (ED472753)

Vehoviak, G. R., Adams, P. F., & Bruening, T. H. (1994). A sustainable farm plan activity. *The Agricultural Education Magazine.67*(l), 8-10, 13.

Waters, R. G., & Haskell, L. J. (1989). Identifying staff development needs of cooperative extension faculty using a modified Borich needs assessment model. *Journal of Agricultural Education, 30*(2), 26–32.

Watson, K., & Halse, C. M. (2005). Environmental attitudes of pre–service teachers: A conceptual and methodological dilemma in cross–cultural data collection. *Asia Pacific Education Review, 6*(1), 59–71.

Weigel, R., & Weigel, J. (1978). Environmental concern: The development of a measure. *Environment and Behavior, 10*(1), 3–15.

Williams, D. L. (2000).Student knowledge of and expected impact from sustainable agriculture. *Journal of Agricultural Education, 41*(2), 19-24.

Williams, D., & Wise, K. (1997). Perceptions of Iowa secondary school agricultural education teachers and students regarding sustainable agriculture. *Journal of Agricultural Education, 38*(2), 15-20.