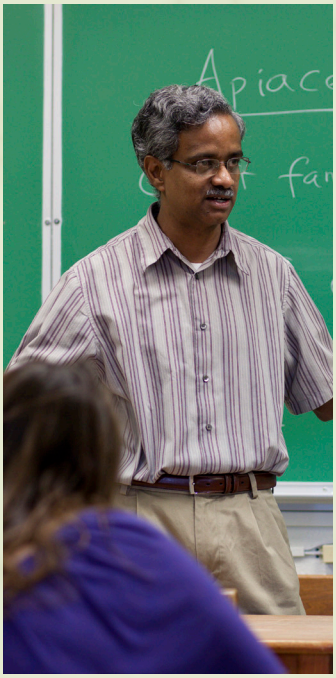
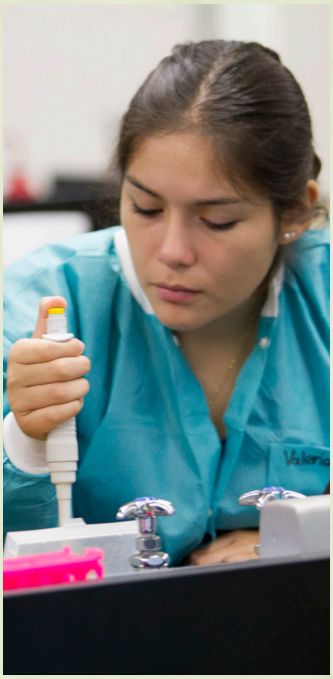
AMERICAN ASSOCIATION FOR AGRICULTURAL EDUCATION NATIONAL RESEARCH AGENDA

2016-2020





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EXECUTIVE SUMMARY

The American Association for Agricultural Education (AAAE) is a professional society for university faculty and graduate students interested in agricultural communications, education, extension, and leadership. As social scientists working in a context of food, agriculture, and natural resources, AAAE members are uniquely positioned to bridge the gap between the general public and scientists working to solve current and emerging challenges related to sustainably feeding an ever-growing population under complications from changing weather patterns. AAAE members are also positioned well to build human and institutional capacity needed by a variety of public, private, and nonprofit employers in the sector. AAAE members are further positioned to develop human capacity and provide leadership within communities.

Recognizing the great potential for contributing to solving these grand challenges, leaders in AAAE decided in 2006 to create a set of research priorities to communicate and coordinate research being conducted by AAAE members (Osborne, 2006). In 2010, a second version of research priorities was established (Doerfert, 2010). Five years later in 2015, the AAAE Board of Directors authorized the development of this, the third AAAE National Research Agenda.

The National Research Agenda Revision Committee used a four-stage Delphi process to identify, refine, categorize, and prioritize research questions for the years 2016-2020. The Delphi panel included 10 active AAAE researchers and 9 engaged stakeholders in a position to understand the real challenges which could be addressed by AAAE research.

Overall, panelists identified 25 priority research questions, and categorized them as seven research priorities. The panel retained the six priorities from the second AAAE National Research Agenda: (a) *Public and Policy Maker Understanding of Agriculture and Natural Resources*; (b) *New Technologies, Practices, and Products Adoption Decisions*; (c) *Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century*; (d) *Meaningful, Engaged Learning in All Environments;* (e) *Efficient and Effective Agricultural Education Programs*; and (f) *Vibrant, Resilient Communities*. The panel added a seventh priority area: *Addressing Complex Problems.*

The panel ranked all 25 research questions (see Table 1 in this document). Based on the expert opinion of the panel, the ten highest priority research questions for 2016-2020 are:

1. What methods, models, and programs are effective in preparing people to solve complex, interdisciplinary problems (e.g. climate change, food security, sustainability, water conservation, etc.)?
2. What evaluation methods, models, and practices are effective in determining the impacts of educational programs in agriculture and natural resources?
3. What strategies are effective in recruiting diverse populations into agriculture and natural resources careers?
4. How can teaching, research, and extension programs in agricultural leadership, education, and communication address complex interdisciplinary issues (e.g. climate change, food security, sustainability, water conservation, etc.)?
5. What methods, models, and programs are effective in preparing people to work in a global agriculture and natural resources workforce?
6. What methods, models, and programs are effective in communicating with diverse audiences?
7. How can formal and nonformal curriculum in agriculture and natural resources address emerging, complex issues (e.g. climate change, food security, sustainability, water conservation, etc.)?
8. How do digital technologies impact learning in face-to-face and online learning environments?
9. What methods, models, and programs are effective in informing public opinions about agriculture and natural resource issues?
10. What are effective models for STEM (science, technology, engineering, and math) integration in school-based agricultural education curriculum?

AAAE members should consider the priorities outlined in this document to ensure their research programs contribute to addressing the priorities and questions raised by the expert panel. Graduate students should review this document when selecting a thesis or dissertation topic. Results from research conducted on these questions should be shared publically through formal outlets such as journals, but also through appropriate methods that enable stakeholders to apply research to improve practice.

Introduction

This National Research Agenda serves as a guiding document for research conducted by members of the American Association for Agricultural Education (AAAE). It can be used by internal audiences, such as faculty and graduate students, to identify and prioritize research efforts over the next five years. It can be used with external audiences, such as university administrators, funding agencies, and stakeholder groups, to explain how we have chosen to focus our research efforts. The ideas presented in this document represent a slice in time look at key issues affecting social science perspectives in food, agriculture, and natural resource systems.

Members of the American Association for Agricultural Education (AAAE) have a long history of conducting high quality applied research focused on problems faced by a wide variety of stakeholders. Our expertise allows us to address social science issues within food, agriculture, and natural resource systems. However, we are a relatively small profession that cannot be all things to all people. We must focus our efforts and work collaboratively to address the most pressing issues. This National Research Agenda provides a guiding document to help us in this effort.

Historically, our research was typically focused on local or state issues with little or no coordinated national efforts. Further, our research was often reactionary and frequently led by graduate students. Consequently, impacts from AAAE members' research were minimized. Recognizing the need for systematic and focused research efforts across the country, AAAE members decided they should have a National Research Agenda.

In 2006, Dr. Ed Osborne at the University of Florida led an effort to create the first National Research Agenda for the period of 2007 to 2010 (Osborne, 2007). This first Agenda was a monumental accomplishment as it brought together a diverse representation of our discipline involved in multiple professional associations and stakeholder representatives. It was presented as a National Research Agenda for Agricultural Education and Communication, larger than just the American Association for Agricultural Education. It was organized around the contextual areas of (a) agricultural communications; (b) agricultural leadership; (c) agricultural education in domestic and international settings: extension and outreach; (d) agricultural education in university and postsecondary settings; and (e) school based agricultural education. There were 22 Research Priority Areas comprised of 59 research questions. This first National Research Agenda provided a great platform to build on and was an instrumental first step in our continuous evolution as a discipline.

In 2010 Dr. David Doerfert at Texas Tech University led the development of the second National Research Agenda (Doerfert, 2010). Unlike the first Agenda, this version was exclusively framed within the American Association for Agricultural Education and input for the Agenda was provided by 136 AAAE members and then synthesized and categorized by a committee of AAAE members. This version of the Agenda made a shift in the way it framed the research problems, focusing on six crosscutting Research Priority Areas and including 22 research objectives across those six areas. As written, most of the 22 research objectives were very comprehensive and too complex to be completely addressed in a single research study or within the five-year period of the Agenda.

After receiving the charge from the AAAE membership to begin the revision process for the third version of the National Research Agenda, we sought to develop a process based on four key principles. First, the identified research questions should be specific and researchable. Second, research questions should reflect internal and external perspectives. Third, impacts from our research should be realized within the five-year period of this Agenda. Fourth, not all research questions are of equal importance. Based on these principles, we outlined the process explained below.

Process

The National Research Agenda Revision Committee began the revision process by establishing an effective and efficient process for developing a consensus of the Research Priority Areas for the next five years. After receiving the charge to begin, the Committee decided a Delphi process was an appropriate methodology. An outline of our proposed process was sent to the AAAE Research Committee in November 2014 for comments and feedback. After receiving their feedback, we adjusted the process and sent it to the AAAE Executive Committee for approval, which was granted in January 2015. The complete process is described below and we hope we have established a replicable process for future revision teams.

Our first step was to recruit the expert panel. We decide *a priori* to have a panel with 8 to 10 *engaged research scholars* in AAAE, which we operationalized as people actively engaged in conducting research and who have the capability to look forward to see the most pressing issues, and 8 to 10 *engaged stakeholders*, which we operationalized as people with an understanding of our expertise and capable of identifying the most pressing

issues that could be addressed by our research. A call for panel nominations was sent over the AAAE listserv. In total, 19 AAAE members were nominated as *engaged research scholars* and 41 individuals were nominated as *engaged stakeholders*. The Revision Committee met to review the nominations and select panelists who brought geographic and institutional diversity, as well as perspectives from our traditional stakeholders in communication, education, extension, and leadership. Our intent was to bring as much diversity to the panel as possible, so we did not set *a priori* quotas for any specific subset of our profession which may have limited or constrained our ability to capitalize on the depth and breadth of the nominations. Ultimately we selected a 20-member panel and 19 members actively engaged in the process. Panel members are presented in Box 1..

Round 1

Round 1 was conducted over a 2-week period in March/April 2015. Panelists were sent a link to an online questionnaire with a single open-ended question, "What are the specific problems that our research should address in the next 10 years? (Please be as specific as possible and list as many you feel are necessary.)" After two reminders, 15 of the 19 panelists responded and provided a total of 96 proposed research questions or problems. The National Research Agenda Revision Committee used a constant-comparative technique (Glaser & Strauss, 1999) to synthesize those 96 items into 30 potential research questions to be considered in Round 2.

Box 1: Delphi Panel

Dr. Dwayne Cartmell, Professor, Oklahoma State University, Stillwater, Oklahoma

Dr. Nina Crutchfield, Local Program Success Specialist, National FFA Organization, Romance, Arkansas

Mr. Coleburn Davis, Director of Organization Programs, Texas Farm Bureau, Waco, Texas

Mr. William L. Deimler, Agricultural Education Specialist, Utah State Office of Education, Salt Lake City, Utah

Dr. David L. Doerfert, Associate Chair and Professor, Texas Tech University, Lubbock, Texas

Dr. Kim Dooley, Professor and Associate Dean for Academic Operations, Texas A&M University, College Station, Texas

Dr. M. Craig Edwards, Professor, Oklahoma State University, Stillwater, Oklahoma

Dr. K. S. U. "Jay" Jayaratne, Associate Professor and State Leader for Extension Evaluation, North Carolina State University, Raleigh, North Carolina

Ms. Lisa Fleming, Director of Global Education Programs, The World Food Prize Foundation, Des Moines, Iowa

Dr. Kay Kelsey, Department Head, University of Georgia, Athens, Georgia

Mr. Brad Moffitt, Director of Market Development and Membership, Ohio Corn and Wheat Growers Association, Delaware, Ohio

Ms. Renee Pardello, Assistant Dean, University of Minnesota Extension, St. Paul, Minnesota

Dr. Nick Place, Dean for Extension and Director of UF/IFAS Extension, University of Florida, Gainesville, Florida

Dr. Rama Radhakrishna, Professor, The Pennsylvania State University, University Park, Pennsylvania

Dr. Jeff Ripley, Associate Director - County Operations, Texas A&M AgriLife Extension Service, College Station, Texas

Mr. Matthew Swartz, Field Force Effectiveness Training Lead, Syngenta, Greenwood, Indiana

Dr. Nicole Stedman, Associate Professor, University of Florida, Gainesville, Florida

Dr. Robert M. Torres, Professor and Department Head, University of Arizona, Tucson, Arizona

Dr. M. Susie Whittington, Professor, The Ohio State University, Columbus, Ohio

Round 2

Round 2 was conducted in later April, 2015. In Round 2, panelists were asked to rate 30 research questions using a five-point Likert scale (*strongly disagree, disagree, neither agree or disagree, agree, strongly agree*). Panelists were also given the ability to suggest wording changes to existing items and to suggest additional research questions. Based on established precedence in the profession, it was decided *a priori* to retain all items in which two-thirds of the panel either agreed or strongly agreed (Martin, Fritzsche, & Ball, 2006; Shinn, Briers, & Baker, 2008; Shinn, Wingenbach, Briers, Lindner, & Baker, 2009).

After two reminders, all 19 panelists responded during this round and 24 of the 30 items were retained. Suggestions for rewording were received for all 24 items. One item was split into two items and another 22 items were slightly reworded, resulting in 25 items moving on to Round 3. The panel also suggested 26 new items, but after the rewording noted above the Revision Committee decided the reworded 25 items had already captured the essence of what panelists suggested.

Round 3

Round 3 was conducted in May 2015. For Round 3 it was decided *a priori* to categorize the 25 items retained from Round 2 using the six Research Priority Areas identified in the 2010-2015 AAAE National Research Agenda (Doerfert, 2010). However, the Revision Committee felt a new seventh Research Priority Area had emerged from the data provided by the expert panel (see Box 2). Consequently, the 25 research questions retained from Round 2 were organized into the seven Research Priority Areas and presented to the panel. Panelists were asked to: (a) rate 25 research questions using a 5 point Likert-type scale (*strongly disagree, disagree, neither agree or disagree, agree, strongly agree*); (b) suggest rewording for each item; and (c) indicate if the research question was categorized into the most appropriate Research Priority Area. After two reminders, 18 of the 19 panelists participated in this round. All 25 items were retained; 11 items were slightly reworded based on panel feedback; and the panel ratified the categorization of all 25 items into the seven Research Priority Areas.

Round 4

Round 4 was conducted in June 2015 to prioritize the 25 research questions identified by the expert panel. Panelists were provided a list of the 25 research questions arranged by the mean scores from Round 3. The instructions stated:

These 25 research questions are the result of your input throughout the last 3 rounds of data collection. Your last task is to rank these items from most important to least important. The initial order is based on the mean scores from Round 3. The final rankings will help researchers (especially graduate students) prioritize their research efforts. You can now look at the entire list and drag and drop to arrange items based on your personal opinion.

After two reminders 14 of the 19 panelists responded. Four of the 25 items maintained their rankings, while 21 of the 25 were adjusted up or down based on panel input. The overall rankings are presented in Table 1.

Box 2: Research Priority Areas

Research Priority 1: Public and Policy Maker Understanding of Agriculture and Natural Resources

Research Priority 2: New Technologies, Practices, and Products Adoption Decisions

Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century

Research Priority 4: Meaningful, Engaged Learning in All Environments

Research Priority 5: Efficient and Effective Agricultural Education Programs

Research Priority 6: Vibrant, Resilient Communities

Research Priority 7: Addressing Complex Problems

Table 1: Overall Rankings

RANK	RESEARCH QUESTION	PRIORITY AREA
1	What methods, models, and programs are effective in preparing people to solve complex, interdisciplinary problems (eg. climate change, food security, sustainability, water conservation, etc.)?	Research Priority 7: Addressing Complex Problems
2	What evaluation methods, models, and practices are effective in determining the impacts of educational programs in agriculture and natural resources?	Research Priority 5: Efficient and Effective Agricultural Education Programs
3	What strategies are effective in recruiting diverse populations into agriculture and natural resources careers?	Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century
4	How can teaching, research, and extension programs in agricultural leadership, education, and communication address complex interdisciplinary issues (eg. climate change, food security, sustainability, water conservation, etc.)?	Research Priority 7: Addressing Complex Problems
5	What methods, models, and programs are effective in preparing people to work in a global agriculture and natural resource workforce?	Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century
6	What methods, models, and programs are effective in communicating with diverse audiences?	Research Priority 5: Efficient and Effective Agricultural Education Programs
7	How can formal and nonformal curriculum in agriculture and natural resources address emerging, complex issues (eg. climate change, food security, sustainability, water conservation, etc.)?	Research Priority 7: Addressing Complex Problems
8	How do digital technologies impact learning in face-to-face and online learning environments?	Research Priority 4: Meaningful, Engaged Learning in All Environments
9	What methods, models, and programs are effective in informing public opinions about agriculture and natural resource issues?	Research Priority 1: Public and Policy Maker Understanding of Agriculture and Natural Resources
10	What are effective models for STEM integration in school-based agricultural education curriculum?	Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century
11	What are the most effective models for delivering agricultural teacher education programs to reach nontraditional audiences?	Research Priority 4: Meaningful, Engaged Learning in All Environments
12	What methods, models, and programs are effective in preparing people to inform policy makers on agriculture and natural resource issues?	Research Priority 1: Public and Policy Maker Understanding of Agriculture and Natural Resources

RANK	RESEARCH QUESTION	PRIORITY AREA
13	What competencies are needed for an agriculture and natural resource workforce?	Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century
14	What are the short, medium, and long term outcomes and impacts of educational programs in agriculture and natural resources?	Research Priority 5: Efficient and Effective Agricultural Education Programs
15	What methods, models, and practices are effective in recruiting agricultural leadership, education, and communication practitioners (teachers, extension agents, etc.) and supporting their success at all stages of their careers?	Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century
16	How do agricultural leadership, education, and communication teaching, research, and extension programs impact local communities?	Research Priority 6: Vibrant, Resilient Communities
17	What are the appropriate models for engaging volunteers in the delivery of educational programs in agriculture and natural resources?	Research Priority 6: Vibrant, Resilient Communities
18	How can delivery of educational programs in agriculture continually evolve to meet the needs and interests of students?	Research Priority 4: Meaningful, Engaged Learning in All Environments
19	What methods, models, and practices are most effective in leading change?	Research Priority 2: New Technologies, Practices, and Products Adoption Decisions
20	How do school-based agricultural education programs contribute to career and technical education (CTE) and broader educational initiatives?	Research Priority 5: Efficient and Effective Agricultural Education Programs
21	What competencies are needed to effectively educate, communicate, and lead?	Research Priority 3: Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century
22	How do we make project-based learning more relevant in youth programs in agriculture and natural resources?	Research Priority 4: Meaningful, Engaged Learning in All Environments
23	What methods, models, and practices are most effective in diffusing innovations?	Research Priority 2: New Technologies, Practices, and Products Adoption Decisions
24	How can quality agricultural leadership, education, and communication educational programs be delivered in a cost-effective manner?	Research Priority 5: Efficient and Effective Agricultural Education Programs
25	How can agricultural leadership, education, and communication practitioners (teachers, extension agents, etc.) collaborate to deliver educational programs effectively?	Research Priority 5: Efficient and Effective Agricultural Education Programs

Writing

The Revision Committee recruited seven writing teams to each address one of the Research Priority Areas to create the final version of the National Research Agenda document. A request for proposals was sent out over the AAAE List Serve in September 2015. The Revision Committee met to review proposals and selected teams who provided the best opportunity to represent the disciplinary diversity within AAAE. Writing teams were asked to provide a brief introduction for their Research Priority Area and then to briefly summarize contemporary research related to each research question. The Revision Committee provided overall editing of the document. The final products for each writing team are presented in the following sections of this document.

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RESEARCH PRIORITY 1:

Public and Policy Maker Understanding of Agriculture and Natural Resources

Kellie Enns
Colorado State University

Michael Martin
Colorado State University

Debra Spielmaker
Utah State University

Background

Americans have reaped the benefits of a successful agricultural system. According to the United States Department of Agriculture [USDA] (2014), Americans spend less than 10% of disposable personal income on food. The low cost of food in the United States has, in turn, helped society flourish.

Low food costs are the result of a variety of innovations and inventions related to food and fiber production. These innovations and inventions have resulted in larger yields but fewer farmers. This success story has a significant consequence—a society that is disconnected from agricultural production and processing. The current 1% of the U.S. population working on farms is supported by nearly 21 million agricultural sector related U.S. workers, or about 15% of the total U.S. workforce (Goecker, Smith, Smith, & Goetz, 2010). The U.S. agricultural sector annually accounts for 1.6% ($278.4 billion) of the $17.4 trillion U.S. Gross Domestic Product (DGP) (Central Intelligence Agency, 2015). The American agricultural sector will have a tremendous challenge in the decades to come as by 2050 the world's population is projected to reach 9.7 billion people (United Nations, Department of Economic and Social Affairs, 2015). Estimates indicate agriculture production will need to increase from 50-100% to meet the growing population demand (AGree, 2012) with less land and water—while sustaining the planet. While most Americans are not directly involved in agricultural production, daily purchasing and voting decisions made by individuals and policymakers affect the American agricultural system. If U.S. agriculture is going to continue to meet the needs of the U.S. population and address growing global needs, agriculture must be understood and valued by all.

While on-farm participation has been decreasing, public interest in the agricultural system in the United States has been increasing. This increase is evident by the seemingly ubiquitous and growing number of food-related education programs; social *foodie* movements; farmers markets; micro-breweries; food marketing tactics, books, blogs, infographics, and movies; and other types of publications proliferated through online and social media networks (Bond, Capehart, Allen, & Kim, 2015; Pingali, 2010; Todd, 2014). At an even higher level, housing developments are being built and marketed around community gardens, and membership in Community Supported Agriculture groups is on the rise (Runyon, 2013). The increased public interest in agriculture has led to questions about the merits of different agricultural production systems related to personal health, the environment, and the economy. Food safety and health concerns have led many consumers to ask critical questions about food processing (e.g., the public outcry over lean, finely-textured beef or "pink slime") and food production technologies and systems (e.g., genetically modified foods, organic food, clean food, etc.) (Kulchler, 2015; Yadavalli & Keithly, 2014).

Debates on the issues of climate change and water usage have merged environmental and agricultural concerns in many public forums (Heisey & Rubenstein, 2015; Schaible & Aillery, 2012). Lawmakers and political interest groups are considering and litigating an ever-increasing number of laws and regulations which directly impact agriculture. Examples include laws which regulate the raising of poultry and labeling of foods which contain genetically modified organisms (Hemphill & Banerjee, 2015; Mohan, 2015). These challenges will provide an ever-increasing "opportunity for more dialogue between farmers, ranchers, and the American public about how food is grown and raised" (U.S. Farmers and Ranchers Alliance, 2011, para. 2).

Providing the public and policymakers with accurate information about agricultural and natural resource concepts has been an ongoing effort in literature for more than 25 years. The term *agricultural literacy* was coined in the 1970s as a short-hand way to describe the state of knowledge about agriculture among the non-farming population in the U.S. (Mercier, 2015). Later, the National Research Council (1988) defined an agriculturally literate person as one who "would understand the food and fiber system and this would include its history and its current economic, social and environmental significance to all Americans" (p. 8). Others have sought to define agricultural literacy conceptually (Frick, Kahler, & Miller, 1991), cognitively (Powell, Agnew, & Trexler, 2008), through engagement (Meischen & Trexler, 2003; Spielmaker, Pastor, & Stewardson, 2014), and through evidence-based decision-making (Kovar & Ball, 2013).

At the forefront of the discussion regarding public and policymaker understanding of agriculture and natural resources is the operationalization of what constitutes true agricultural literacy. The requirement that a literate person be able to accurately articulate and defend his/her positions and decisions on agriculture is important to understanding our quality of life (Frick et al., 1991; Powell et al., 2008; Spielmaker & Leising, 2013). Perhaps an even greater need in research other than the demonstrable outputs of the agriculturally literate person are those characteristics which influence the development of the literacy. A person's geographic location, occupation, political ideology, family background, education, and experiences would influence how he/she conceptualizes

agriculture (Anderson, Velez & Thompson, 2014; Specht, McKim & Rutherford, 2014). These differences are not minute or trivial and require agricultural professionals to become more flexible in their research, outreach, and teaching in order to more effectively communicate with the public.

A plethora of educational initiatives and groups have formed around the concepts of agriculture, food, and environmental issues; however, the amount, type, accuracy, and quality of agricultural information provided to the general public is unknown. To effectively measure, design, redesign, and possibly leverage successful programs to inform public and policymakers, a refined context of what people need to know about agriculture is necessary. Furthermore, that understanding of agriculture must take into account a person's contextual differences. Agricultural education is not a one size fits all discipline; however, future research with existing or developing frameworks, centered on the conceptualization and operationalization of agricultural literacy, will provide the support needed to determine the most effective methods, models, and programs for informing public opinion and preparing people to inform policymakers on agricultural and natural resource issues.

Research Priority Questions

1. What methods, models, and programs are effective for informing public opinions about agricultural and natural resources issues?
2. What methods, models, and programs are effective in preparing people to inform policymakers on agricultural and natural resources?

Overview of the Literature

Methods of agricultural education.

Generally, educational methods can be described as instructional practices, principles, and strategies that are utilized in educational settings. Methods of educational effectiveness have been the focus of many research studies in school-based agricultural education (Jenkins & Kitchel, 2009; Jenkins, Kitchel, & Hains, 2010), extension education (McKim, Lawver, Enns, Smith, & Aschenbrener, 2013) and literacy programs (Kovar & Ball, 2013). The general consensus drawn from these studies is that different audiences may maximize learning through specific methods. Across all types of programs effective methods are typically varied, personal, relationship-based, well-planned, targeted, interactive, skill-based, or experiential in nature and enhanced through inquiry (Benavente, Jayaratne, & Jones, 2009; Dewell et al., 2015; Lakai, Jayaratne, Moore, & Kistler, 2012; Skelton, Seevers, Dormody, & Hodnett, 2012; Strong, Harder, & Carter, 2010; Thoron & Burleson, 2014). Facilitator- or instructor-led programs were the focus of these studies; however, understanding how the public seeks and values educational programs in self-guided and self-motivated methods of learning is critical. In such instances (news media, magazines, periodicals, or social media, for example) trustworthiness, validity of sources, and context related to the content is of primary importance (Charanza & Naile, 2012; Israel et al., 2015; Specht & Rutherford, 2013).

Models of agricultural education.

Recent studies on models of teaching consumers and informing policymakers have varied. An educational model is a human-constructed system that explains interactions in the world; thus, educational models can be very diverse. Models in agricultural education can and have emerged from theoretical research. Powell et al. (2008) developed a conceptual model for agricultural literacy exemplifying this type of research. While the message of the model is more pragmatic, the model itself is built partially around the outcomes of the theory of cognitive constructive functions. Likewise, some models can be philosophical in nature. Roberts' and Ball's (2009) philosophical article reviewed roles of context and content in secondary agricultural science education. The model which emerged provided a conceptual view of how secondary agricultural science education can develop a skilled agricultural workforce and agriculturally literate citizens. Conversely, some models in agricultural education have been developed by incorporating best practices and evaluations. Conner, Becot, Kolodinsky, Resnicow, and Woodruff (2014) developed a model of teaching agri-food entrepreneurs by incorporating service learning principles and feedback from alumni on the topic. The resulting conceptual model formed the nucleus of a possible class which focused on engaging students in community-based entrepreneurship education. Finally, some models have been developed by incorporating existing models into programming. The review of the Extension program *Grandparents Raising Grandchildren* is one such example of the application of the community mobilizing model (Miller, Bruce, Bundy-Fazioli, & Fruhauf, 2010).

Programs of agricultural education.

The increased popularity of agriculture and agriculture-related topics has led to an increasing number of organizations doing agricultural education work. A variety

of programs in the U.S. seek to educate or inform youth and future policymakers about agriculture and natural resources. The effectiveness of these programs has been the subject of several publications (Kovar & Ball, 2013; Mercier, 2015; Powell & Agnew, 2011). Programs and curriculum projects exist in formal academic settings (e.g., Agriculture in the Classroom; Food, Land & People; Farm to School; FoodCorps), formal career and technical education settings (school-based or secondary agricultural education programs/FFA), and some in nonformal settings (e.g., 4-H, Boy Scouts, Girl Scouts). However, it is estimated these programs are reaching only 2% (in the case of school-based agricultural education programs/FFA) to 12% of the school-age population (in the case of Agriculture in the Classroom) with educational resources and programming (Mercier, 2015). Alternative agricultural education approaches have emerged and gained popularity both locally and nationally, including the Agricultural Council of America (Agricultural Council of America, 2015), Slow Food USA (Slow Food USA, 2015), and community gardening associations (American Community Gardening Association, n.d.).

Conclusions

Agricultural educators, communicators and extension personnel will need to continue to seek methods, models, and programs which best educate the public and policy makers about the important and vital work occurring in the agricultural industry. Rigorous outcome data, beyond local focus, but extended in state-wide, multistate, and even national models will assist in long term effective program development. While individual public entities require specific outcomes, their programs will best be guided by conceptual and t heoretical frameworks grounded in rigorous research studies. As policy makers continue to utilize evidence-based data to make decisions, agricultural educators should increasingly seek input from policy makers in order to determine what data is warranted and how it can best be utilized, and presented (Dhaliwal & Tulloch, 2012).

Finally, as we continue to train agriculture teachers, educators, communication specialists, and advocates who work in both formal and nonformal settings, we must continually seek ways to define effectiveness given our constituency's diverse backgrounds, experiences, and cultures in order to successfully determine program effectiveness. Truly, we need to further refine the goals and expectations of our methods, models, and programs through rigorous, informative evaluation approaches that ultimately drive change in our discipline. Such approaches will assist us in becoming more competitive for grant dollars and private donations seeking to improve educational practices.

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RESEARCH PRIORITY AREA 2:

New Technologies, Practices, and Products Adoption Decisions

James R. Lindner
Texas A&M University

Mary T. Rodriguez
The Ohio State University

Robert Strong
Texas A&M University

David Jones
North Carolina State University

Dale Layfield
Clemson University

Background

In his acceptance speech for the Nobel Peace Prize Norman Borlaug (1970) stated "Civilization as it is known today could not have evolved, nor can it survive, without an adequate food supply" (para. 1). Feeding a world with nine billion people in approximately 35 years will require several key problems to be resolved (U.N. Food and Agriculture Organziation, 2009). One of the key problems to be resolved is developing and diffusing "new technologies that can help us use scarce resources more efficiently, increase and stabilize crop and livestock yields" (FAO, 2009, ¶2). Innovation and the adoption of new technologies will be required to feed an expanding world population (Conway, 2012). Additional research on and a better understanding of new technologies, practices, and products will help agricultural educators develop and implement agricultural teaching and learning processes contributing to the development of sustainable agricultural systems needed in the future. Such work requires we focus not only inwardly on universities and colleges and their faculty and students, primary and secondary schools and their teachers and students, Extension services and outreach institutions and their professionals and clients, but also outwardly toward farmers growing food and fiber, scientists and professionals developing new innovations, people who are not food secure, and political and social systems that contribute to food insecurity.

Research on adoption and diffusion of innovations has been central to the profession of Agricultural Education since the Iowa Study of Hybrid Seed Corn (Rogers, 2003). Rogers' theory of diffusion of innovations is often used as a theoretical framework in the *Journal of Agricultural Education* and other journals in our field of study. Previous *National Research Agendas* have included "New Technologies, Practices, and Products" in the framework.

> To achieve positive outcomes in current and future agriculture-related diffusion efforts, related research, education, and outreach activities must continually change to address the new challenges and opportunities brought about by rapidly advancing technologies; evolving consumer demands, needs, and behaviors; and the need to make positive contributions to environmental, human, and animal health. Our social science research must also remain cognizant that the chains of production, distribution, and marketing of agricultural products are complex. We must create transdisciplinary, systems research approaches that holistically examine technological adaptation and policy design while accounting for all of the components of agricultural systems, from farm to the market and the consumer and back again.
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Rogers (2003) defined innovation as "an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (p. 12). The nature of innovations researched in agricultural education is very broad and includes a variety of *technologies*, *practices*, and *products*. Distance education *technologies* include video conferencing, websites, apps, learning management systems, reusable learning objects, mobile devices, and smart boards. Education programming and *practices* include face-to-face instruction, lecture, demonstration, experiential learning, simulations, web-based instruction, flipped classroom instruction, farmer field schools, and professional learning networks. Products include commodities, farming tools, farming implements, materials, and equipment.

INNOVATION	RESEARCHER
Agribusiness Programming	Kock, Hafer, Smith, & Turnbull (2014)
Distance Education Technologies	Nelson & Thompson (2005) Murphrey & Dooley (2000)
Educational Programming	Rollins (1993) King & Rollins (1995)
Extension Programming	Taylor & Miller (2015) Harder & Lindner (2008a)
Farming Commodities	Poolsawas & Napasintuwong (2013)
Farming Tools	Moriba, Kandeh, & Edwards (2011)
FFA and Diversity	Roberts, Hall, Briers, Shinn, Larke, & Jaure (2009)
Integrated Pest Management and Farmer Field Schools	Erbaugh, Donnermeyer, Amujal, & Kidoido (2010) Dolly (2009)
Inquiry Based Instruction	Wilcox, Shoulders, & Myers (2014)
Social Media	Bowen, Stephens, Childers, Avery, & Stripling (2013)
Sustainable Agriculture Perceptions	Gamon & Scofield (1998)

Rogers (2003) identified five characteristics of an innovation: *relative advantage, compatibility, complexity, trialability,* and *observability*. Rogers (2003) noted that the adoption of an innovation goes through stages: Knowledge, persuasion, decision, implementation, and confirmation. Li and Lindner (2007a) and Harder and Lindner (2008b) and documented the existence of a sixth stage, no knowledge, ranging from approximately 15% to 30% of the population distribution for an innovation. Rogers (2003) noted adoption focuses on how an individual goes through these five stages in accepting or rejecting an innovation; diffusion focuses on the extension of an innovation to a broader system. It is during the persuasion stage that the characteristics are evaluated by an individual. Further, understanding better the advantages and disadvantages of an innovation may reduce uncertainty, thereby aiding acceptance or rejection of an innovation.

Rogers (2003) identified criticisms to adoption and diffusion theory: Pro innovation bias, individual-blame bias, recall, and equality. A general criticism of Rogers' theory is that it presents simplistic view of how individuals' adopt and how innovations are diffused through a system. The complexity of the system is often discounted. Notwithstanding the criticism, the use of Rogers' theory is well established in agricultural education as theoretical framework for understanding adoption and diffusion. Recent examples of its acceptable use as a theoretical framework include: "assess[ing] the acceptance of eXtension among Iowa Extension professions" (Taylor & Miller, 2015, p. 223); "better understand[ing] how and why individuals utilize online resources such as ecommerce" (King, Curry, Meyers, Doerfert, & Burris, 2015, p. 269); and understanding "...how county 4-H program leaders in Tennessee utilize social media and to determine perceptions of 4-H program leaders toward current and future usage of social media communication methods..." (Bowen, Stephens, Childers, Avery, & Stripling, 2013, p. 85).

Research Priority Questions

1. What methods, models, and practices are most effective in leading change?
2. What methods, models, and practices are most effective in diffusing innovations?

Review of Literature

Kotter (2012) identified eight steps to leading change: creating a sense of urgency, building a coalition, developing a vision, communicating the vision, removing obstacles, creating short-term wins, building on the change, and anchoring the change in a culture. Successful changes share a common pattern (Heath & Heath, 2010). They require the leader of change to use our logical and emotional characteristics to shape our path; commonly referred to as changing our situation (Heath & Heath, 2010). Resistance to change can inhibit the adoption and

diffusion of innovations. Wilcox, Shoulders, and Myers (2014) highlighted the needed leadership role of the agriculture education teachers seeking to lead change through the adoption of inquiry-based instruction. When students began to disengage and reject the innovation, teachers who modified their instruction to meet students' unmet needs were able to reengage students and increase likelihood for adoption. A leader's role in facilitating change is to help individuals overcome internal resistance to change.

How innovations are diffused, why innovations are diffused, and how fast innovations are diffused is central to Rogers' (2003) model. Key elements include newness of innovation, presence of communication channel, element of time, and involvement of a social system. Rogers (2003) stated that opinion leadership is how much informal influence an individual has over the attitudes or behaviors of others in regards to an innovation; opinion leaders, therefore, are individuals who have significant influence on the spread of positive or negative attitudes about an innovation. The success of change agents in adopting innovations is positively related to how much the change agent works in conjunction with opinion leaders (Rogers, 2003). Moore, Murphrey, Degenhart, Vestal, and Loux (2012) noted that key opinion leaders were critical in facilitating adoption of the Animal Health Network innovation.

Bowen et al. (2013) studied the adoption and diffusion of social media used by County 4-H Program Leaders in Tennessee and documented the adoption rates and non-adoption rates of social media. They documented the use and effectiveness of using social media as a communications tool. Goswami and Ali (2011) noted that identifying attributes an innovation through participatory approaches added in the adoption of organic agriculture practices. Diker, Walters, Cunningham-Sabo, and Baker (2011) found that simplicity of use and trialability of an innovation are critical attributes needed for adoption of new nutritional educational materials.

A lack of understanding as to the specific causes for the rate of rejection was a determined challenge. Rogers (2003) described rejection as a decision not to adopt an innovation. The culture of a particular society is exceptionally influential in innovation rejection or adoption. The availability of labor is an essential aspect to investigate when determining factors that influence rejection. Li and Lindner (2007b, p. 45) identified ten obstacles to the adoption and diffusion of distance education: "program credibility, administrative support, planning issues, technical expertise, financial concerns, concerns about time, concerns about incentives, infrastructure, conflict with traditional education, and fear of technology." They recommended training as a method for minimizing barriers to adoption. Harder and Lindner (2008a, p. 69) identified five barriers to the adoption and diffusion of eXtension: "Concerns about time, concerns about incentives, financial concerns, planning issues, and technology concerns." They noted barriers can be minimized with prior training to launch of an innovation. Battel and Krueger (2005) identified barriers to the adoption and diffusion of sustainable manure management practices (odor, costs, and weed control) and suggested extension agents, through educational programming and consultation, were critical to helping farmers overcome these barriers.

When developing effective training programs Knowles (1990) wrote there are three characteristics that must exist for learners to learn best. Adult learners are different from younger learners in that adult learners must devote time and energy to learn something with the perception that what they are learning will help them in a specific task in the future. This is different from younger learners that are typically motivated by a reward system of some kind.

The first characteristic that will improve a learner's rate of acquisition of a skill is the objective of the lesson. It is imperative that the learner realizes what is to be learned and why. The objective must answer the question of, "Why am I learning this? What good will it be?" The second characteristic of an effective program is getting the learners involved in the learning process. There are various methods of successful integration of objectives and participants' involvement. Learning exercises and activities are just a few of the ways to involve the learning in the program. Practice sessions where the adult learners can put their skills to work will create greater gains in learning. People learn best while teaching others is the third characteristic to increase the rate of learning. One of the primary differences between young learners and adult learners is adult learners bring experience into their own learning. It is critical to capitalize on this and allow the adult learner to integrate and use this in his/her new learning environment.

Social networks are the patterns of friendship, advice, communication, and support that exist amongst people within a social system (Valente, 1996). Social networks have the ability to facilitate or impede the diffusion of an innovation within a social system (Rogers, 2003). These social networks serve to give context to the environment for adoption of an innovation. Rogers (2003) made clear the innovation should be in accordance with the societal norms and appropriate for usage for a certain population. The impact of the social structure on adopter's perceptions

of an innovation have been researched in terms of social integration (Burt, 1980). Rogers (2003) operationalized this in his explanation of time of adoption. The extent to which a person's patterns of relations with others in a system integrates him or her further into the system, leading to greater exposure to people with experience with the innovation and thus becoming an 'opinion' leader within that system (Burt, 1980). These change agents and opinion leaders make the difference with innovation adoption. These opinion leaders will be among the first to adopt an innovation when it is consistent with prevailing norms (Rogers, 2003).

Social systems can be complex and multifaceted. In Rogers' (2003) definition of diffusion he stated that the social system is an essential component of the adoption process, however, the social system itself can hinder the adoption of an innovation. Innovations have elements of uncertainty and risk. This encourages individuals to rely on those with prior experience with the innovation (Valente, 1996). Potential adopters rely on relationships to provide them with information. An important component of the social system is the communication that occurs amongst members of that social system. This communication can be in favor of or against an innovation and can have significant effects on the potential adopters' perception of the innovation.

Studies have explored the influence the social system can have on adoption. Valente (1996) noted that the behaviors of others influences a person's decision to adopt. Rogers (2003) stated that there is more to the social system's influence on adoption other than when the individual makes the decision to adopt the innovation or the effects of opinion leaders. Valente (1996) proposed personal network thresholds, which seek to measure adoption thresholds in terms of direct communication network links with others in the social system. In this case, the personal networks that a potential adopter belongs to will determine their exposure to the innovation itself. This is where the social system has its greatest influence. The more exposure individuals have to other innovation adopters, the more communication about the innovation they will receive and their adoption likelihood increases. As complex as social systems can be, their effect on adoption cannot be overlooked.

Venkatesh, Morris, Davis, and Davis (2003) developed a Unified Theory of Acceptance and Use of Technology (UTAUT). Their research showed UTAUT explained a majority of variation for intention to adopt technology; outperforming all other models and theories studied. Models and theories UTAUT was based on include: Theory of reasoned action (TRA) (Fishbein & Ajzen, 1975); the technology acceptance model (TAM) (Davis, 1989); the motivational model (MM) (Davis, Bagozzi, & Warshaw, 1992); theory of planned behavior (TPB) (Ajzen, 1991); the TAM/TPB model; the PC utilization model (Thompson, Higgins, & Howell, 1991); theory of diffusion of innovations (Rogers, 1995); and social cognitive theory (Bandura, 1986). UTAUT includes four constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions). Teo and Noyes (2014) found UTAUT helped explain preservice teachers' intention to adopt technology. Teo and Noyes (2014) noted further "there was evidence…to suggest that the strength and influences of the core determinants [performance expectancy], [effort expectancy], [social influence] and [facilitating conditions] on the behavioral intention use technology may interact differently when the UTAUT is applied to different technologies, user populations and cultures" (p. 64). Bumguardner, Strong, Murphrey, and Dooley (2014) used UTAUT as a theoretical framework to study student use of blogs in the classroom. Their findings showed "students with low belief in the performance benefit of blogging do not intend to blog" (Bumguardner, Strong, Murphrey, & Dooley, 2014, p. 38).

Understanding how educational technologies in the classroom impact the teaching and learning process can help agricultural educators better contribute to growth and sustainability of agricultural systems in the future. Dooley, Lindner, and Dooley (2005) noted educational technologies can promote, detract, or not affect teaching and learning. Ely (1999) described eight conditions that can be used in developing, implementing, and evaluating educational technology innovations. Ely's (1999) eight conditions include: dissatisfaction, competence, resource availability, time availability, rewards, participation, commitment, and leadership. Based on Ely's conditions, Ensminger, Surry, Porter, and Wright (2004) identified four underlying factors for implementation of educational technology innovations: managed change, performance efficacy, rewards, and resources. Ferster (2006) developed a predictive model for explaining the diffusion of technology in primary and secondary classrooms. They studied over 40 educational technologies and concluded Rogers' (1995) attributes of an innovation helped predict the diffusion of technology in primary and secondary classrooms. Contemporary innovations (educational technologies, practices, and products) whose attributes should be evaluated to determine their viability for improving the teaching and learning process in agriculture classrooms include the value of computer programming to student success, teacher competence with emerging educational technologies, use of social media as a formal educational tool, use of mobile

devices as a formal educational tool, student research projects that add value to society, role of interaction and collaboration in the classroom and society, role of student choice and learning contracts in educational activities, and technology integration policies that increase participation in the classroom.

Many times, beneficial innovations are rejected. One reason for this can be the incompatibility of the innovation with the cultural system of the adopters. Rogers (2003) mentioned several failed interventions. In his discussion, Rogers briefly mentioned the innovation's incongruity with the beliefs of the cultural system. Culture can be defined as a system of values (Dubois, 1972). These values can be described in terms of cultural norms. It is important to see if that culture values change and innovation. An innovation's adoption likelihood is critically dependent upon the nature of the cultural values and norms fundamental to the system (Dubois, 1972).

An adoption can have increased economic returns for individuals choosing to adopt (Gangi & Wasko, 2009). Individuals chose to adopt based on the social benefits that may result from adoption the innovation (Ozaki, 2011). The adoption of innovations has been attributed to individuals' desire to enhance the environment in which they live and work (Damanpour & Schneider, 2006). One innovation with profound impact on societal, environmental and safety issues is the solar home systems in the off-grid solar market in Africa. Paired with another innovation known as pay-as-you-go (PAYG), many Africans have replaced Kerosene lamps with "pico-solar" systems that provide brighter lighting and extended lighting time by one hour each day (Harrison, Scott, & Hogarth, 2016). This additional length of night lighting allows more study time for children and parents to extend their work hours by shifting others tasks to the longer evenings Harsdorff and Bamanyaki (2009). In many households across Zambia, Malawi, Uganda and Kenya, kerosene use was completely eliminated through use of the solar systems. One report noted that 40% of solar light users indicated that kerosene lamps created various health issues, including respiratory issues, eye irritation and strain and headaches (Harrison, Scott, & Hogarth, 2016).

Tambe, Hitt, and Brynjolfsson (2012) indicated the adoption of innovations can positively influence an organization's production. Adopting an innovation has the opportunity to enable organizations and individuals to improve safety in the workplace (Bunduchi, Weisshaar, & Smart, 2011).

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RESEARCH PRIORITY 3:

Sufficient Scientific and Professional Workforce That Addresses the Challenges of the 21st Century

Christopher T. Stripling
The University of Tennessee

John C. Ricketts
Tennessee State University

Background

The growth in population and the need for food; the challenges of water, soil, and habitat conservation; improving nutrition and public health; and strengthening farms, agricultural workers, and communities (AGree, 2012) make *Priority 3: Sufficient Scientific and Professional Workforce that Addresses the Challenges of the 21st Century* a problem of focus in every sector of the agricultural industry and for all aspects of agricultural education (formal, nonformal, K-12, postsecondary, youth, adult, agricultural literacy, marketing, media campaigns, etc.).

The range of issues and subject matters important to agriculture has broadened, and the educational system to provide skilled individuals to fill the needed occupations has scrambled to keep pace. The crucial areas of expertise now encompass not just those trained in production agriculture but also food and nutrition, natural resources, and the know-how to maintain and improve the physical and scientific infrastructure that underlies modern agriculture, including an increased role for information technology with the emergence of "big ag data" (Mercier, 2015, p. 1).

In a *USA Today* article, Krogstad (2012) wrote concerning higher education in agriculture: "Enrollment is booming…as students flock to study subjects they feel offer a clear path to a job upon graduation" (para. 1). Education in and about agriculture and related areas is attractive because skills are developed that can solve issues such as global hunger, obesity, food safety, and climate change. The excitement is well-timed, as researchers have noted expected growth in the human population will result in a 50% increase on the demand for food over the next two decades (Hazel & Wood, 2007) and a 70-100% increase in demand by 2050 (Godfray et al., 2010).

As a result, employment opportunities in agriculture-related fields continue to increase. Projections for 2015-2020 show an increase of more than 5% for graduates with postsecondary degrees, which is an average of 57,900 annual openings (Goecker, Smith, Fernandez, Ali, & Theller, 2015). Furthermore, 35,400 or 61% of the annual openings will be filled with new U.S. graduates – leaving employers to fill the other 39% with nonagricultural graduates (Goecker et al., 2015). In response to this continued trend, the National Research Council (2009) called for colleges and universities to reach out to secondary-school students and teachers and "explore partnerships with youth-focused programs, such as 4-H, National FFA, and scouting programs" (p. 9) to expose students to agriculture and generate interest in agricultural careers. In addition to youth programs, nongovernmental organizations, agricultural employers, and agriculture industry professionals serve a vital role in the workforce supply chain (National Research Council, 2009). Forming partnerships among the aforementioned groups may increase awareness of the multidisciplinary and challenging nature of agriculture and could increase the diversity of students seeking postsecondary degrees and careers in the agricultural sciences (National Research Council, 2009).

In recent decades the agricultural sector struggled to attract underrepresented students, especially those from low income and underserved communities (Talbert & Larke, 1995), but recent years have seen an increase in minority undergraduates in colleges and departments of agriculture (United States Department of Agriculture, 2014). Although progress has been made in increasing the number of underrepresented students as agricultural professionals, this trend will need to continue. According to the U.S. Census Bureau (2012), the percentage of Whites in America will decrease, and the percentage of African, Asian, Hispanic or Latino, and Multicultural Americans will increase in the next 35 years.

Furthermore, agricultural practices in the United States are not disconnected from the rest of the world. "Through social, cultural, political, and economic integration, we are now connected to one another in ways, both simple and complex, never before experienced" (National Research Council, 2009, p. 15). In today's world, employers realize their personnel will work with people from other parts of the world, and in this connected world, the role of agricultural education should evolve to meet the needs of a global food and agricultural enterprise (National Research Council, 2009). Graduates need to be exposed to and experience international perspectives to fully understand the connected nature of agriculture and be better prepared to address critical demands placed upon our agricultural systems (National Research Council, 2009).

In addition to global competency, "the modern workplace requires workers to have broad cognitive and affective skills" (National Research Council, 2011), and as a result, employers are demanding employees have soft skills, often referred to as 21st century skills, upon entering the workforce (National Research Council, 2012). Furthermore, the National Research Council's (2009, 2012) reports entitled, *Transforming Agricultural Education for a Changing World* and *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century* called for the development of 21st century skills among U.S. students. Agricultural education must

determine the most effective means for incorporating and assessing soft skills development (National Research Council, 2009) in both formal and nonformal settings.

Addressing the complex economic, social, and environmental challenges related to agriculture is dependent upon our ability to prepare a sufficient scientific and professional workforce that understands the multidisciplinary nature of agriculture and is diverse, globally competent, and possesses 21st century skills.

Research Priority Questions

1. What strategies are effective in recruiting diverse populations into agriculture and natural resource careers?
2. What methods, models, and practices are effective in recruiting agricultural leadership, education, and communication practitioners (teachers, extension agents, etc.) and supporting their success at all stages of their careers?
3. What competencies are needed for an agriculture and natural resource workforce?
4. What methods, models, and programs are effective in preparing people to work in a global agriculture and natural resource workforce?
5. What are effective models for STEM integration in school-based agricultural education curriculum?
6. What competencies are needed to effectively educate, communicate, and lead?

Overview of Literature

Recruitment.

Agriculture is a broad industry with very diverse career options, but these options are not always known to prospective students (Baker & Abrams, 2011). Recruiting students requires consideration of generational influences (Wildman & Torres, 2001), which affect career decisions (Twenge, 2014). Today's students want to "feel important" and "believe that they are making a personal impact" (Twenge, 2014, p. 271). This sentiment is consistent with Baker, Settle, Chiarelli, and Irani (2013) who found students are more apt to respond to positive contextual messages, want to see passion in current employees of their prospective career, seek job related opportunities to give back or help others, desire knowledge of job stability and availability, and appreciate one-on-one recruitment strategies. Understanding what prospective students are attracted to and selecting strategies to publicize those perspectives (Baker, Settle, Chiarelli, & Irani, 2013) will aid in recruiting students for all aspects and settings of agriculture and natural resources.

Career Decision Making theories purport people make career decisions based on self-characteristics, job requirements (Krumboltz, 1996), and logic regarding the interaction between the job environment and those self-characteristics (Holland, 1997). In addition to environmental conditions and events, Mitchell and Krumboltz (1990) added learning experiences, skills, genetic endowment and special abilities (including race, sex, or physical disability) are all determinants of career choice. If ethnicity and diversity have an impact on a student's decision to enter the agricultural sciences, how does it impact those decisions, and is there anything that can be done to attract underrepresented groups to agriculture and natural resources? According to the National Research Council (2009), only modest gains have been seen in baccalaureate-degree recipients among minorities. Research is needed to help the profession do a better job of attracting underrepresented people into secondary and postsecondary teaching positions, Extension positions, and other professional careers to assist in the future recruitment of underrepresented students and their placements in agriculture and natural resource-related jobs in hopes of reaching communities that remain relatively untouched.

Workforce preparedness.

There is a great divide between employers' beliefs and high school and college students' perceptions about what it means to be workforce ready. For example high school and college students are "less likely to define preparedness in terms of personal traits or work ethic" (Lawson, 2014, p. 6). "Likewise, nearly one-quarter of [employers] include 'personal traits,' such as adaptability, having a good attitude, being respectful and maturity in their definition of preparedness, compared to only 8 percent of high school students and 10 percent of college students" (Lawson, 2014, p. 6). Students in agricultural communications, Extension, and leadership are not exempt from this divide. We must build our research programs in these areas to close the gap of workforce preparedness.

The industries we serve need the 21st century skills our academic programs develop in our students, as evidenced by a growing body of research. In a national assessment of agricultural employers, Crawford, Lang, Fink, Dalton, and Fielitz (2011) identified soft skill clusters that are essential for successful employment in the food and agricultural sciences: (a) experiences, (b) team, (c) communication, (d) leadership, (e) decision making/problem-solving, (f)

self-management, and (g) professionalism. Similarly, the Association of Career and Technical Education (2010) stated critical thinking, adaptability, problem solving, oral and written communications, collaboration and teamwork, creativity, responsibility, professionalism, ethics, and technology use as skills needed in the 21st century. They also noted academic and technical (job-specific) skills were needed to be career ready. Furthermore, in today's world, the education students receive cannot be concerned only with national interests. Most educational leaders agree education should prepare students to live and work in a global economy and society. In fact, internationalization, or steps taken by an academic institution and/or individuals to manage the dynamic global academic environment (Altbach & Knight, 2007) is becoming a mainstay in education. Keeping with the times, universities will have to produce cross-culturally competent citizens who can lead and compete in diverse and global marketplaces (Jayakumar, 2008).

Utilizing research to draw a connection between the impact of our academic programs and student preparedness and success is essential for survival and sustainability of agricultural leadership, education, and extension education, but also for agricultural communication. For example, agricultural communication organizations had 100% agreement in one study that graduates should possess the ability to communicate agriculture to the public, and navigate and understand agricultural policy, geography, word processing, creativity, campaign planning, graphic design, news writing, reporting, editing, ethics, design/layout, problem solving, speech writing, oral communications, script writing, and applying concepts during an internship (Terry, Vaughn, Vernon, Lockaby, Bailey-Evans, & Rehrman, 1994). Unfortunately, it is still unclear if our graduates, regardless of the discipline, have amassed these types of communication competencies or requisite leadership skills. Agricultural education research also seeks to connect its educational programs to 21st century skills and communication competencies. Much of the research in school-based agricultural education focuses on teaching-related issues.

Evidence is starting to emerge on effective practices for science, technology, engineering, and mathematics (STEM) integration in school-based agricultural education as well; however, the literature and scope of current works are limited in this field too. The Math-in-CTE model (Stone, Alfeld, Pearson, Lewis, & Jensen, 2006) has shown promise for enhancing the mathematics found within the school-based curriculum, while not diminishing technical skills (Parr, Edwards, & Leising, 2006, 2008; Young, Edwards, & Leising, 2009). Early research has also shown promise for incorporating the Math-in-CTE model into preservice agricultural teacher education (Stripling & Roberts, 2013, 2014). Furthermore, inquiry-based instruction and the use of Vee maps appear to positively impact science student achievement (Thoron & Myers, 2010, 2011, 2012). Thoron and Myers suggested when school-based teachers are provided professional development related to the aforementioned strategies and given guidance and feedback on their instruction, science student achievement is advanced. Outside of school-based agricultural education, instructional strategies such as the WISE Seed Discussions, 5E Model, and Learning by Design show promise for improving science achievement and 21st century skills (National Research Council, 2010). The effectiveness of these strategies and other science education strategies should be explored in school-based, postsecondary, and nonformal agricultural education as a means for developing a scientific and professional agricultural workforce.

Internationalization of higher education has been defined by many participants (both educators and researchers) in rather different ways. Internationalization in higher education is defined by Knight (1997) as a process of integrating an international perspective into the teaching/learning, research, and outreach functions of colleges and universities. However, how an international perspective is integrated within a university is dependent on individual interpretations (Khalideen, 2006). Harder et al. (2015) noted employers want graduates with an experience abroad, even though they were fairly indifferent about the value of cultural and global competencies. Harder et al. also found leadership and communication skills were desired by employers.

Higher education literature suggests racially and ethnically diverse student populations enable colleges to provide their students with skills and abilities that will prepare them for future employment (Jayakumar, 2008). Furthermore, many have emphasized curriculum as an important element of internationalization (Knight, 2000), and others have argued internationalized curricula are integral to any process of internationalization education (Bond, 2003). The basis of this approach is the internationalized curricula would have a strong focus on international approaches to subject matter and would allow for exploration of economic, social, cultural, and political lives of people and societies within a global framework. Internationalizing curricula is a powerful and practical way of bridging the gap between rhetoric and practice to including and valuing the contribution of international students (Leask, 2001). If curriculum is the most important element of internationalization, engagement of faculty will also be a

critical element for successful internationalization efforts (Green & Olson, 2003). This is understandable, as faculty directly impact teaching, research, and outreach missions of higher education institutions.

However, the "research to date provides little guidance about how to help learners aggregate transferable competencies [and skills] across disciplines" (National Research Council, 2012, p. 7). Research has shown the importance of linking existing knowledge to new knowledge or concepts (Schunk, 2012) and strategies that may support the development of knowledge and skills needed in the 21st century are (a) using multiple and varied representations of concepts and tasks; (b) encouraging elaboration, questioning, and explanation; (c) engaging learners in challenging tasks with supportive guidance and feedback; (d) teaching with examples and cases; (e) priming student motivation; (f) using formative assessments; and (g) modeling and feedback techniques that highlight the processes of thinking rather than focusing exclusively on the products of thinking (National Research Council, 2012). These strategies may be key in developing a scientific and professional agricultural workforce for the 21st century.

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RESEARCH PRIORITY 4:
Meaningful, Engaged Learning in All Environments

Don W. Edgar
University of Arkansas

Michael S. Retallick
Iowa State University

David Jones
North Carolina State University

Background

Effective teaching has continually been hampered by pedagogical constraints, such as time, materials, and ever changing technological advances. There are various interpretations on how best to incorporate educational practices to better educate learners. Besides incorporating pedagogical tenets, a need for understanding the learning environment has been espoused by many. There is a lack of broad-based, empirical evidence regarding how effective agricultural education is in attracting young people to all sectors of agriculture as well as a lack of coordination in terms of curriculum development, program implementation, and monitoring success, which likely reduces the potential for impact (Mercier, 2015). Today's learners are progressive, and societal needs have changed considerably with communication advancements and access to personal technologies (Caton-Rosser, Looney, & Schneider, 2014). Therefore, today's learners need high-level cognitive abilities and a more personal instructional design.

Meaningful learning begins when learners progress from low-level learning such as rote memorization to interpretation, analysis, and evaluation based on sound pedagogical principles (Edgar, 2012; Schunk, 2004). Meaningful learning should engage the learner in the process and not just as the recipient of knowledge. Solving a problem or working through a project provides a context whereby the learner(s) must reconcile new knowledge with existing knowledge, apply it to gain resolution of the educational objective(s), and transfer what is learned to future experiences. In addition to content knowledge, employers are demanding transferrable competencies including interpersonal communication skills, critical thinking skills, problem solving skills, writing skills, and computing skills (National Research Council, 2009a).

For Millenials (Generation Y), the Internet has been ever present in their lives and has caused them to be characterized as "detached from institutions and networked with friends" (Taylor, 2014, p. 112). Pintrich and Zusho (2007) posited "student motivation is a persistent and pervasive problem for faculty and staff at all levels of postsecondary education" (p. 731). Based on this assumption and the fact that student-to-student networking is important, creating meaningful, engaged learning opportunities is paramount in future learning environments. Technology and online communications are dominant forces in students' lives and as a result today's 21st century students, parents, and teachers are demanding a 21st century education (Greenwood, 2007) which includes collaboration, communication, critical thinking, and creativity.

The National Research Council (2009b) has called for a paradigm shift in how colleges of agriculture adapt their mission because of global integration, environmental concerns, demographic and political shifts, consumer influence, and advances in sciences. Reform is required to meet the needs of today's and future students through a changing world and to minimize the technology gap between educator and student. It is essential to explore educational opportunities in all areas including (a) traditional formal settings such as high schools and post-secondary schools as well as elementary and middle schools where teachers integrate food and agriculture into existing curricula, (b) various types educational systems including private and charter schools or rural and urban settings, (c) nonformal settings like FFA, 4-H, Agriculture in the Classroom and other out-of-school programs like Boy and Girl Scouts, YMCA, and Boys and Girls Clubs of America (Mercier, 2015).

Two challenges facing agricultural education today include the need for a critical mass of the next generation of agriculturalists interested in food and agriculture and to educate those who do not understand food and agriculture systems (Mercier, 2015). Consequently, many have called for a change of instructional methodology from passive, teacher-centered instruction to active, student-centered instruction (Arum & Roksa, 2011; Smith, Sheppard, Johnson, & Johnson, 2005). Woolfolk (2010) said understanding the diversity of students in today's classrooms may allow a better understanding of why traditional educational practice needs to be reorganized to create improved learning environments, providing the following statistics to make her case. In 2003, 12% of the people living in the United States were born in countries outside the United States and spoke a language other than English at home. In 2006, almost 20% of American children lived in poverty, which is 50% higher than any other developed Western nation. By 2020, over 66% of all school-age children in the United States will be African-American, Asian, Hispanic, or Native-American. By 2050, no major race or ethnic group will prevail in the United States, every American will be a member of a minority group. One child in three is born to unmarried parents, one in five is born to a mother who did not graduate from high school, and one child in three lives with a single parent (usually a working mother). Finally, nine million children in the United States are food insecure and one in three are obese.

Enhanced understanding of learning and teaching environments could result in the development of present-day best practices and research-based pedagogies and technologies that not only meet the goal of agricultural education but also society's greatest challenges.

Research Priority Questions

1. How do digital technologies impact learning in face-to-face and online learning environments?
2. What are the most effective models for delivering agricultural teacher education programs to reach nontraditional audiences?
3. How can delivery of educational programs in agriculture continually evolve to meet the needs and interests of students?
4. How do we make project-based learning more relevant and contemporary in youth programs in agriculture and natural resources?

Overview of Literature

Bain (2004) concluded the "best teaching cannot be found in particular practices . . . but in the *attitudes* of the teachers, in their faith in their student's abilities to achieve, in their *willingness* to take their students seriously and let them assume control of their own education, and in their *commitment* to let all policies and practices flow from central learning objectives" (p.78-79). In order to enact these attributes, instructors are encouraged to think backwards from what is expected to be the key concepts learned in a course and design instruction to aid students in gaining skills and knowledge throughout the course as a means of meeting learning objectives based on how students learn best. Therefore, it is vital educators determine the best way to teach and distribute agricultural information to students for optimal long-term retention (Frick, Birkenholz, & Machtmes, 1995; Pense & Leising, 2004).

Student interests and motivations have changed and there is a need to explore those elements that are personally and professionally rewarding and align with their values and interests while maintaining a work-life balance (National Research Council, 2009a). People do not have one style of learning they use at all times and in all situations. Everyone uses a blend of these attributes and selectively, based on motivation and interest, utilizes one type more than another (Richlin, 2006). Doyle (2011) described the teacher as shifting from the spokesperson of knowledge to the architect of learning. Engaged learners will associate meaning as they are immersed in the learning process when guided through the experience in a purposeful manner by the facilitator. Creating and evaluating meaningful learning environments is essential to educating future generations. This task is complex and many assumptions about pedagogical practice should be investigated to determine appropriate processes to guide engagement and learning. The need for meaningful, engaged learners exists in all environments and research in all five disciplinary dimensions (agricultural communications, agricultural leadership, school-based agricultural education, extension and outreach education, and agricultural education in university and post-secondary settings) is needed.

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RESEARCH PRIORITY 5:
Efficient and Effective Agricultural Education Programs

Andrew C. Thoron
University of Florida

Brian E. Myers
University of Florida

R. Kirby Barrick
University of Florida

Background

The central mission of agricultural education programs is the preparation of educators in agriculture, with applications including more than the preparation of school-based agricultural education teachers (Barrick, 1993). Programmatic areas such as extension education and agricultural mechanization were historically a part of or closely related to agricultural education in the public schools. More recently, agricultural communication and agricultural leadership have joined agricultural teacher education and extension in broad-based agricultural education programs. While teaching and learning is central and helps to form the bonds among the disparate program foci, "the application of the teaching/learning process can be made in a variety of other settings" (Barrick, 1993, p. 12).

Currently, a shortage of scientists for agricultural positions exists throughout the United States (U.S.). Employment data from Employment Opportunities for College Graduates in the U.S. Food, Agricultural, and Natural Resources System (CSREES, 2005) projected a deficit of nearly 3,000 agricultural graduates per year for 2005-2010. The latest report projecting career opportunities for 2010-2015 (NIFA, 2010) projected an even greater deficit. Compounding the issue of recruiting and preparing qualified graduates to enter careers in agricultural sciences is the increasing demand for workers with scientific expertise by numerous career areas. Science, technology, engineering, and math (STEM) occupations are critical to the continued economic competitiveness of the U.S. (Carnevale, Smith, & Melton, 2011). The demand for traditional STEM workers will continue to grow.

Opportunities for educators, industry leaders, and communicators to expose potential employees to the benefits of and skills used in the diverse array of agricultural careers are great, and occur across a broad timeline during an individual's life, both before and after entering the adult workforce. While many colleges of agriculture have experienced an increase in student enrollment, fewer students maintain their agricultural focus through successful placement in an agriculturally-based scientific position upon graduation (Dyer, Lacey, & Osborne, 1996).

Career and technical education (CTE), including agricultural education, focuses heavily on career exploration as well as career and college readiness in order to help students better understand the skill, knowledge, and education expectations of specific careers (DeLuca, Plank, & Estacion, 2006). While no direct link has been established to connect successful secondary school experiences in agricultural education all the way through the human capital pipeline to successful employment in agricultural careers, studies have shown that "students' course taking during high school plays a critical role in their ability to transition to postsecondary education and pursue a range of postsecondary majors and degree options" (Laird, Chen, Levesque, & Owings, 2006, p. 1). Dyer et al. (1996) found that while the percentage of freshman students with secondary school agricultural education was declining, the percentage of students intending to graduate with a major in agriculture was much higher among students with secondary school agricultural education experience than among those with no previous agricultural education experience. Dyer, Breja, and Wittler (2002) found enrollment in a high school agricultural education program to be one of the most influential factors in whether students completed a degree in a college of agriculture. Enrollment in agriculture courses at the secondary school level has also been found to be correlated with high positive perceptions of agriculture (Smith, 2010).

Although it is important for agricultural educators to be able to discuss the application of principles from all aspects, the science and math concepts in the context of agricultural education have garnered the most attention in the literature base because of their direct application to agriculture. Myers, Thoron, and Thompson (2009) conducted a study to determine what teachers needed in order to successfully emphasize STEM concepts in their classrooms. The responses of the National Agriscience Teacher Ambassador Academy participants were categorized as the following: (a) curriculum, (b) professional development, (c) teacher preparation programs, (d) philosophical shift, and (e) collaboration. Teachers in the study desired an agriculture curriculum written to be aligned with state and national standards for science and math along with a national database of lesson plans containing explicit emphasis of STEM concepts made available to teachers. Teachers also desired continuing instruction on how to highlight science and math principles found in the agriculture program. The teachers in the study believed pre-service teachers should be required to take coursework at their university to strengthen their knowledge of such a curriculum. The teachers also reported desiring a shift in philosophy regarding agricultural education. Teachers in the study believed transforming the view of agricultural education would help teachers of all disciplines understand the role agriculture can take in increasing student achievement. The teachers also valued collaboration, and believed team-teaching across disciplines would help to reinforce the importance of agricultural education and make the agricultural

educators a valuable part of the education community (Myers, Thoron, & Thompson, 2009).

Rumble et al. (2016) examined a contemporary issue in agriculture: the science of genetic modification. The implications and recommendations from that study probably apply to other subjects. Those concepts included the need for university faculty to make connections between science and values, for secondary school teachers to apply issues-based instruction to communicate science, and for extension educators to partner with others in providing information and educational programs for scientists, farmers, and consumers to interact (Rumble et al., 2016). Agricultural education teachers, extension educators, and agricultural leadership and agricultural communication professionals must collectively provide cutting edge educational programming.

Research Priority Questions

1. What evaluation methods, models, and practices are effective in determining the impacts of educational programs in agriculture and natural resources?
2. What methods, models, and programs are effective in communicating with diverse audiences?
3. What are the short, medium, and long term outcomes and impacts of educational programs in agriculture and natural resources?
4. How do school-based agricultural education programs contribute to career and technical education (CTE) and broader educational initiatives?
5. How can quality agricultural leadership, education, and communication educational programs be delivered in a cost-effective manner?
6. How can agricultural leadership, education, and communication practitioners (teachers, extension agents, etc.) collaborate to deliver educational programs effectively?

Overview of the Literature

School-based agricultural education.

Agricultural education in middle and high school incorporates numerous factors that require a unique set of skills aside from the typical educational factors that are associated with student academic success. Management and advisement of a comprehensive student leadership organization (National FFA Organization) that develops leadership skills and career development applications through competitive events, classroom and laboratory facilities management, Supervised Agricultural Experiences (where students engage in authentic experiential learning), and, in many states, industry certification are all components of school-based agricultural education.

Factors attributing to student academic success have been identified through teaching methodologies such as inquiry-based instruction where Thoron and Myers (2011, 2012a, 2012b) found students outperformed peers on subject matter exams, argumentation skill, and scientific reasoning when compared to a more traditional approach to teaching during a fourteen-week study. The authors called for studies of longer duration in the profession and replication. Other studies (Stripling & Roberts, 2014) have investigated the math ability of students enrolled in teacher preparation programs and thus the preservice teachers' self-efficacy (Stripling & Roberts, 2013) in teaching math concepts in an agricultural context. Further investigations attributing agriscience education to academic success are pivotal to the future of school-based agriculture in the public schools. In addition to academic success in the classroom, there remains a value in indicating further development for students beyond the secondary-school. Impact of industry certifications, students' ability to obtain an associate degree while in high school linked to career success, due to school-based agricultural education, provide little guidance to the profession above the perception level.

In addition to student academic success in the classroom, there remains a focus of teacher time spent advising an FFA chapter. Consideration of contextual differences between the rural and urban FFA chapters may lead to more diversity in school-based agricultural education (Martin & Kitchel, 2015). The advising impact on students' leadership skills resulted in small-to-moderate gains in transformational leadership skill (Rosch, Simonsen, & Velez, 2015). This study also found female students made significant gains in transformational leadership skill while no changes emerged in the male students. Ricketts, Osborne, and Rudd (2004) also found FFA and advisement differences in goals between genders. Agricultural leadership and agricultural communication professionals should play an integral part in agricultural education.

Another factor in school-based agricultural education is the development of career aspirations through FFA career development events (CDEs). Benefits of career development events have been studied and continue to be a focus of school-based agricultural education. Landry,

Ramsey, Edwards, and Robinson (2015) conducted a Delphi study that identified benefits of CDEs, as perceived by school-based agricultural education teachers in Oklahoma. The authors concluded teachers perceived CDEs supported career and life skills and had benefits for student employment. Sapp and Thoron (2014) linked student academic success and career development events when they discovered students were gaining argumentation skill through preparation for the agricultural sales CDE. Similar opportunities exist through extension education.

The use of laboratory facilities remains a consistent focus of school-based agricultural programs. How programs utilize laboratories for learning (Shoulders & Myers, 2012) or assessment tools in the laboratory setting (Thoron & Rubenstein, 2013) will help explain the need for experiential learning through investigations in the schools across the U.S. Experiential learning through supervised agricultural experiences (SAE) has a long history in school-based agricultural education. Many studies have focused on the growth of SAE (Retallick & Martin, 2008), while some identified successful student experiences (Rubenstein & Thoron, 2014) and factors that existed in a high school agricultural program (Rubenstein & Thoron, 2015).

In conclusion, academic success of school-based agricultural education and the advisement and use of the student leadership organization have many attributes, yet many questions remain for further authentic investigations. However, Mercier (2015) pointed out in a national report that agricultural education ought to be reaching more students and involve the community and literacy efforts, that student leadership organizations should reach a larger population, and that the goals and efforts should be broadly defined.

Teacher preparation.

For nearly a century, teacher preparation has been an integral part of university–based agricultural education programs. Through the collaborative efforts of teachers, state supervisors, and university faculty, agricultural teacher preparation has served as the major source of secondary school agriculture teachers in the United States. While various structures exist among the approximately 80 agriculture teacher preparation programs (Barrick & Garton, 2010), several attributes are common. Most are located within colleges of agriculture and related sciences and vary across the states, from the traditional four-year degree with a major in agricultural education to five-year programs, master's programs, and alternative certification programs (Barrick & Garton, 2010). However, programs are designed to include components of general knowledge, agriculture knowledge, and teaching and learning to meet university degree and state certification requirements (Barrick & Garton, 2010; Myers & Dyer, 2004) and serve as the central function of the departments in which they are housed (Barrick, 1993; Barrick & Garton, 2010; Shinn & Cheek, 1981). Closely related programs of agricultural communication, extension education (Shinn & Cheek, 1981), leadership education (Andenoro et al., 2013) and agricultural awareness (Kahler, 1988) provide additional context for the development of professionals with competencies in teaching and learning. Collaborative efforts are essential in ensuring that all graduates of multi-disciplinary agricultural education programs possess adequate knowledge and skill in planning, delivering, and assessing programs. Agriculture teachers in particular must be well-prepared to provide students with the technical and personal skills and qualities needed to obtain employment and establish themselves in a career (Hughes & Barrick, 1993).

To further advance agricultural education programs, a number of studies have identified key issues and proposed actions to be taken. A continuing need for increased emphasis on cultural diversity in agricultural education has been reported as well as gender representation (LaVergne, Larke, Jr., Elbert, & Jones 2011; LaVergne, Jones, Larke, Jr., & Elbert, 2012; Talbert & Edwin, 2010; Vincent, Kirby, Deeds, & Faulkner, 2014; Warren & Alston, 2007). Other researchers have addressed components of the program such as the need to clarify, document, and assess the purpose and activities of field-based programs (Smalley, & Retallick, 2011), the technical abilities of agricultural education graduates (Scanlon, Bruening, & Cordero, 1996), and the performance measures for assessing programs (Belcher, McCaslin, & Headley, 1996).

Agricultural education is a distinct part of career and technical education (CTE) as both have evolved from occupational education and vocational education. Bail (1972) made the case many years ago that career and technical education should be able to identify the skills and abilities, the understandings, and the knowledge needed by workers in any occupation. Extending beyond the traditional, agricultural education should be at the forefront in career competency development for agriculture teachers as well as extension educators, agricultural communicators, agricultural leadership educators, and university faculty. An investigation by Israel, Myers, Lamm, and Galindo-Gonzalez (2012) reported the performance of CTE students in science, leading to the need for emphasizing the connections between agricultural topics and science principles in agriculture teacher education programs. Such an endeavor would help address the need

to identify curriculum and instruction changes to include evidences reported by the U.S. Department of Labor and others (2014).

In summary, agricultural education should further develop research activities to address these topics and to address the historical needs identified by Buriak and Shinn (1993), Williams (1991), Curtis (1969), and Shinn, Briers, and Baker (2008) in order to discover the outcomes, impact, and benefits of university agricultural education programs.

Graduate education.

Graduate education in agricultural education has in many respects been the "silent partner" alongside undergraduate teacher preparation programs. However, it has received some attention in the literature. Shinn and Baker (2010) provided a description of graduate programs in agricultural education. In this description it was noted that changes were occurring in how graduate degree programs were structured (specialization vs. foundational courses), how courses were delivered (face-to-face vs. distance), and the demographics of students enrolled. All of these observations lead to important questions that should be addressed by the profession.

Shinn and Baker's (2010) description, as well as the balance of the literature in agricultural education, does not clearly articulate the purpose of graduate education in agricultural education. There has been some work done in the area of what experts agree should be included in a doctoral-level degree plan in the discipline (Shinn, Briers, & Baker, 2008), yet there is still more to be done. Further, little to no conversation has occurred regarding the purpose of the many different types of master's degrees available in agricultural education. One could argue that this purpose of graduate education question needs to be addressed to guide the discussion regarding the structure and delivery of graduate degrees in the profession.

In addition to program characteristics, the individual student factors that lead to successful completion of graduate degrees also need to be investigated. Similar work has been done by Graham and Garton (2001) regarding the use of teacher certification measures for teacher preparation degrees. If certain factors were found to lead to successful graduate degree programs, prospective graduate students could utilize this information to best prepare themselves for success in graduate education.

Opportunity also exists to deliver agricultural education graduate degree programs that model collaboration and better prepare graduates for careers in agricultural education, broadly defined. Studies that clearly articulate the needs of graduates entering careers in school-based agricultural education, extension education, and other forms of formal and non-formal education are needed to assist faculty in designing and refining graduate education in the profession.

Professional development.

Efforts to lead change or reform in agricultural education very often include some form of professional development. However, the structure and format of those professional development opportunities often differ. Desimone (2009) proposed a list of empirically-based core features to be incorporated into professional development activities, including a focus on content, active learning strategies, coherence between new content and previous knowledge and beliefs, sufficient duration, and collective participation among teachers. Continued research in the context of agricultural education – formal and non-formal education settings – is needed to evaluate the effectiveness of these established professional development attributes and can greatly improve the body of knowledge on effective professional development. Research in this area is important as previous research has shown the characteristics of professional development influenced the impact that training had on behavioral change (Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet, Porter, Desimone, Birman, & Yoon 2001; Shoulders & Myers, 2014). It has been further noted educator professional identity may also play a role in the effectiveness and delivery mode for professional development (Shoulders & Myers, 2011). This idea warrants further investigation to determine how the professional identity of the members of the various stakeholder groups served by agricultural education influence how professional development opportunities are designed and delivered.

The knowledge and skill needed by agricultural education professionals, including university faculty, will continue to grow as our society and the needs of stakeholders continue to become more complex. In addition to the growing knowledge base, agricultural educators will need to develop skills in developing capacity in an ever more diverse client base. Basic and advanced skills in program development, delivery, and evaluation will be essential (McClure, Fuhrman, & Morgan, 2012).

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RESEARCH PRIORITY 6:
Vibrant, Resilient Communities

Donna L. Graham
University of Arkansas

Shannon Arnold
Montana State University

K.S.U. Jayaratne
North Carolina State University

Background

The Center for Rural Affairs (n.d.) is calling for a *rural recovery* as communities are experiencing significant declines in population, businesses, jobs, and vibrancy. Rural to urban outmigration is growing as people seek greater employment, education, stability, and life choices in cities (Economic Research Service, USDA, 2014). Small and rural communities are experiencing economic challenges due to globalization and industry transformation (Dickes & Robinson, 2010) with aging populations, fewer workers, low-skill jobs, higher poverty rates, and declining revenues (Gibbs, Kusmin, & Cromartie, 2005). As a result of these human capital and labor market constraints, communities are unable to implement competitive economic approaches necessary to prosper (Dickes & Robinson, 2010). Some areas have lost the local school, causing confusion in the community's existence and often producing a loss of identity. Many communities are facing the exodus of the brightest youth to urban areas where employment opportunities are more diverse than rural areas. To address the loss of human and social capital, progressive community programs, policies, and local partnerships are needed (Dickes & Robinson, 2010).

"Vibrant communities provide support that meets basic needs . . . promote inclusion to enable all members to participate actively in social, economic, cultural, and political life . . . afford opportunities for the lifelong acquisition of knowledge and skills" (Torjman, 2001, p. 47). "A sustainable community is one that nurtures its natural, human and financial capital so that the community continues to improve" (Hart, 1998, para. 9). Human capital includes volunteer efforts, the governing structure, and the skills and education of the community members and their health (Hart, 1998). An important part of human capital is the connection among people. A stronger relationship between and within youth, adults, and other community entities strengthens communities. Extension and agricultural education programs develop and utilize these networks to enhance relationships, educational efforts, resources, and services that build central community connections (Seevers & Stair, 2015). An opportunity exists to study the cultivation of external and internal relationships of leaders and community members and how these relationships contribute to community capacity.

"Community resilience is a measure of the sustained ability of a community to utilize available resources to respond to, withstand, and recover from adverse situations" (Rand, 2013, p. 1). Resilience includes the ability to "anticipate risk, limit impact, and bounce back rapidly through adaptation, evolution, and growth in the face of turbulent change" (Community & Regional Resilience Institute, n.d., para. 1). A resilient community can thrive in an environment of change (Magis, 2010). Agriculture faces the perception of crisis when the media show exemplars, visually vivid and emotionally strong content. An organization needs a response strategy when faced with a crisis (Irlbeck, Jennings, Meyers, Gibson, & Chambers, 2013; Sellnow & Sellnow, 2014). Community leaders need to have the skills to handle risk and potential crises effectively, make timely and appropriate decisions, locate needed resources, and mobilize and organize citizens to work together (Littrell, n.d.). High rates of turnover in community leadership and personnel has a serious impact on the resiliency of a community. There is a need to explore the essential communication and leadership skills of community leaders, personnel, and volunteers to effectively handle complex community challenges.

When resources are limited, volunteers are critical in planning and delivering programs vital to serving diverse client groups (Culp, 2012; Kelly & Culp, 2013). The lack of volunteers causes concern, yet youth and senior citizens complain of not being asked to participate in meaningful ways. Small communities face declining numbers of volunteers and burnout of existing volunteers (Culp, 2013). Communication is crucial to cross generations and find a meaningful way to include all in the future planning process (Terry, Pracht, Fogarty, Pehlke, & Barnett, 2013). An increased understanding of volunteer management and coordination would strengthen efforts made by community leaders as they organize and execute a community vision (Ripley, Cummings, & Lockett, 2012). Further research is needed to study innovative models of engaging volunteers in the delivery and evaluation of effective educational programs.

Effective leadership is necessary to advancing a community's future (Starkweather, 2015, para. 17). Leadership is needed to manage public discussion as communities face complex public issues. However, in many communities, board members experience high turnover, conflict, mismanaged legal issues, and compromised financial performance (Barnes & Lachapelle, 2011). "Leadership and organizational training for private and public boards is vital for effective decision making" (Barnes & Lachapelle, p. 1). A need exists for comprehensive and context-specific materials for community leadership programs. Further research is needed to understand and develop a mindset of leadership as a system that is enhanced and developed from an engaged and resilient community.

"Communities that view their citizens as the greatest asset and invest in the development of the full potential of all their people are those who will have the capacity to compete effectively in the global political, social, and economic arena" (Littrell, n.d. p. 1). While local agricultural education teachers and extension personnel can provide the training needed for youth and adult leaders, retention is of concern. Further research is needed for maintaining resiliency in agricultural educators and local leaders.

Education enables citizens to deal with difficult issues, enhance trust and relationships, and build skills for idea generation and decision-making. Communities that invest in themselves can keep and attract people who energize communities and create new networks (University of Minnesota, 2009). The ultimate goal of community capacity building is to deal with community problems without relying on external resources (Romanini, 2014). Overall, research is needed to determine the impacts of educational programs and models for improved accountability of the educational enterprise.

Research Priority Questions

1. How do agricultural leadership, education, and communication teaching, research, and extension programs impact local communities?
2. What are the appropriate models for engaging volunteers in the delivery of educational programs in agricultural and natural resources?

Overview of Literature

Building community resiliency.

Since 2001, the policy of the United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) is to "be prepared to respond swiftly in the event of security, technological, or natural disasters . . . in order to provide support and comfort to the people of the United States" (Jepsen, Reshan, & Mann, 2013, p. 1). This responsibility has added the need for crisis communication plans within the community environment (Jepsen et al., 2013). They found "preparedness at the organizational level had a relational effect to the amount of support available to communities in their hour of need" (Jepsen et al., 2013, p.1). All leaders should be accountable for maintaining sustainable, safe, resilient communities.

"Community-based interventions are becoming more holistic in approach, more multidisciplinary in nature, and more complex in function" (Braverman, Franz, & Rennekamp, 2012, p. 1). Dickes and Robinson (2010) posited communities must develop programs and policies that build regional partnerships to prevent human capital constraints. Peer-learning and networking opportunities were the most influential strategies to advance regional public policy engagement (Majee & Maltsberger, 2012). Community coalitions enable community members to make efficient, effective, and sustainable change (Smathers & Lobb, 2013). Extension personnel can provide leadership, technical assistance, and unbiased information. Miller, Bruce, Bundy-Fazioli, and Fruhauf (2010) advocated that a community mobilization model could be replicated in addressing diverse issues and building capacity. Moss and Bond-Zielinski (2010) found using the logic chain was an effective framework for strategic planning and visioning to build consensus among diverse members.

Education is critical to a resilient community to increase knowledge, improve practices, and influence behaviors. Culp (2013) reported Extension has long relied on volunteers to transfer knowledge and skills to communities. Involving volunteers benefits the community and the organization by expanding its outreach efforts. Majee and Maltsberger (2013) reported a collaborative public policy engagement program holds promise for sustaining communities. Prokopy et al. (2012) found public participation in local decision-making was inconsistent between communities, but primarily influenced by the local context. Social capital is created when residents are involved in making decisions about community issues; however, residents from small town, cities, or farms have the least involvement (Civittolo & Davis, 2011). Money, human capital, and turnover of leadership are barriers to a community's ability to carry out community improvement (Nix, Eades, & Frost, 2013). Improving tourism has been proven to build rural economic resiliency, community motivation, and positive visitor perceptions (Akin, Shaw, & Spartz, 2015). Tourism can be developed around existing community assets, including "natural resources, outdoor sports, and recreation, agriculture, and unique cultural features to increase economic benefits" (Akin et al., 2015, p. 1; Hugo & Lacher, 2014; Norby & Retallick, 2012). Other community-based programs can be created based on the needs, skills, and attributes of people in the area.

Resiliency of agricultural and extension educators.

With the increasing demand for impacts required by stakeholders, the issues of resiliency and burnout should be addressed to retain local leaders, specifically in agricultural and extension education. Theiman, Marx, and Kitchel (2014) found positive youth experiences, job certainty, and encouragement were critical to resilience

in teaching. In a related study of stress, burnout, and resiliency, Theiman, Henry, and Kitchel (2012) found daily stressors play a greater role in adding stress compared to sporadic incidences. Job resiliency was managed by effective time management, a strong system of support, pride in achievements, as well as other characteristics. Langley, Martin, and Kitchel (2014) reported cultural distance and social connectedness in a new community could influence a novice teachers' general well-being. Similarly, Young and Jones (2015) found job embeddedness was a factor in extension agent retention. Research shows extension agents are satisfied with the social service nature of work, fit of position, job creativity, challenges, and organizational values, but dissatisfied with compensation, advancement, and policies (Arnold & Place, 2010; Hodous, Young, Borr, & Vettern, 2014). These findings were similar to agricultural education teachers.

Agricultural and extension educators identified community engagement as an important competency for professional success and agreed the missions of 4-H and FFA support collaboration in an era of limited resources, time, facilities, and expertise (Seevers & Stair, 2015). Loss and turnover of personnel is not only costly, but reduces human capital (Brodeur, Higgins, Galindo-Gonzalez, Craig, & Haile, 2011). Researchers found job training aimed at increasing competencies, social skills, and satisfaction can improve retention (Baker & Hadley, 2014). Entry level experiences related to mentoring and networking were valuable experiences for new employees. Early career professionals differed from older extension agents in the request for online professional development options. Increased work load, lack of time, and funding were the most constraining barriers for extension agents acquiring competencies (Lakai, Jayaratne, Moore, & Kistler, 2012). Harder, Gouldthorpe, and Goodwin (2014) found both motivating and maintenance factors as most important for agent retention.

Leadership and community resiliency.

An opportunity for research exists in regards to the development and cultivation of external and internal relationships between leaders and community members. By further developing interpersonal skills, community leaders can be strengthened from stronger relationships with youth, adults, and other community entities. The ability of local advisory boards "to function as the primary visioning/needs assessment source is paramount to maintaining the grassroots connection for programs" (Ripley, Cummings, & Lockett, 2012, p. 1). Elected and appointed leaders in communities "need skills to effectively and efficiently carry out the responsibilities of the position" (Davis & Lucente, 2012, p. 1). They found local government leadership education training helped increase confidence levels, broaden perspectives, and improve empathy for community members. Leaders learned to apply emotional intelligence to inspire commitment, motivate others, and build lasting relationships (Chen, King, Cochran & Argabright, 2013). Walker and Gray (2009) concluded leaders should be inspiring and have a shared vision for their community, seek leadership development opportunities, enable others to act, be role models in their communities, and help the community to accomplish goals. Ripley, Cummings, and Lockett (2012) found "leadership advisory board members felt confident in their ability to scan the community and identify relevant issues, but more training and orientation was needed" (p. 3). Lachapelle, Austin, and Clark (2010) concluded a citizen-based planning process may prove valuable in improving and strengthening community leadership.

Managing and engaging volunteers in the delivery of educational programs.

"Volunteers are an important part of American society as well as a critical element of community programs" (Culp, 2012, p. 1). As communities grow and diversify, more volunteers will be needed to extend programs, services, and limited financial and human resources (Kelley & Culp, 2013). A stronger understanding of volunteer administration, management, and coordination can strengthen efforts made by leaders as they execute community decisions. Tools and approaches used to manage different generations, genders, backgrounds, and ages should also change with society trends. Andrews and Lockett (2013) found Generation Y volunteers have unique needs, require new management styles, and engage in the use of technology more than previous generations. New strategies are needed to improve volunteer opportunities, programs, and management approaches.

Volunteer behavior and consumer behavior loyalty are similar. Terry et al. (2013) learned satisfaction from the experience leads to higher retention and organizational commitment. Also, understanding the motives of volunteers aids in recruiting volunteers. Schrock and Kelsey (2013) found 4-H leaders have a need for affiliation and achievement. Other motivations for volunteers include building knowledge and skills, personal fulfillment, addressing community problems, altruism, and humanitarian concerns (Akin, Shaw, Stepenuck, & Goers, 2013; Wilson & Newman, 2011). Mobilizing volunteers

consists of engaging, motivating, and supervising (Culp, 2013). "If volunteers are engaged too quickly, this will result in frustration, poor performance, and lower retention rates" (Culp, 2013. p. 1). Further research is needed to understand the motives, engagement, and satisfaction of volunteer service.

Mentoring is "an effective method of helping inexperienced individuals develop and progress in their profession" (Byington, 2010, p. 1). Byington (2010) found a successful mentoring relationship included trust, clearly defined roles and responsibilities, establishment of short and long term goals, using open and supportive communication, and solving problems in teams. Adults, parents, and non-parents significantly influence the pathways and decisions of youth; however, not all adults have been trained on how to be a positive mentor (McNeill, 2010). Additional research on effective mentoring programs can assist volunteers in adjusting to their various roles.

Community professionals must "give volunteers programmatic ownership, the resources and the education needed to complete their tasks" (Cassill, Culp, Hettmansperger, Stillwell & Sublett, 2010, p. 1). Orienting and training volunteers is critical to success. Online, asynchronous modules and technologies made learning more convenient and flexible for volunteer training (Ouellette, Lesmeister, Lobley, & Gross, 2014; Robideau &Vogel, 2014). Using technology greatly increases efficiency, communication, and organizational ability (Davis & Rice, 2014; Ferree, 2015; Terry, Harder, & Zyburt, 2014). "In economic downtimes, it is, even more, necessary to look at creative ways to deliver programs and services" (Cassill et al. 2010, p.1). Several models have been successful in administering effective volunteer programs (Cassill et al.2010; Corp, Rondon, & Van Vleet, 2013; Culp, 2012; Culp, Tichenor, Doyle, Stewart, & Hunter, 2010; Dillivan 2013; Meeks & Culp, 2011 Schmitt-McQuitty, Smith, & Chin, 2011; Young, Alexander, & Smith, 2013). Additional research is needed to investigate appropriate models of volunteer program administration for a range of volunteer abilities, knowledge, and skills.

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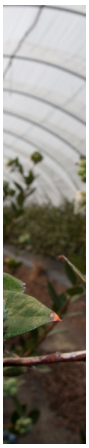
RESEARCH PRIORITY 7:
Addressing Complex Problems

Anthony C. Andenoro
The University of Florida

Matt Baker
Texas Tech University

Nicole L. P. Stedman
The University of Florida

Penny Pennington Weeks
Oklahoma State University



Background

The innovative, inventive, and creative activities that have brought growth, progress, and perspective to our global communities have become the impetus for every challenge that we face globally. Through the modification and "enhancement" of our planet, we have dramatically impacted almost every region. This has resulted in complex adaptive challenges that threaten human wellbeing and global sustainability. In today's global environment complex adaptive challenges are those in which technical solutions of the past are no longer viable options. These adaptive challenges are rich with complexity, embody the diversity and scope of human knowledge, and require multiple perspectives and systems thinking to develop and implement sustainable solutions. Further, singular expertise is not sufficient. We will need to seek interdisciplinary understanding, which leads to transdisciplinary solutions if we aspire to sustain our growing global population.

Our most pressing complex adaptive challenges stem from global population growth. The global population is expected to exceed 9.725 billion by 2050 (United Nations, 2015). This creates significant concerns for the fields of Agriculture and Natural Resources. Specifically, these issues can be seen in five main areas – Space, Agricultural Production, Natural Resource Management, Energy Consumption, and Climate Change (Brown, 2012; Emmott, 2013; Stedman & Andenoro, 2015).

Space.

Space and and how we use it is a critical challenge. The World Bank (2015) reported nearly 40% of our all of our available land on Earth is being used for food production. However, as our population grows our cities will expand to accommodate the need for more housing. Considering that it is projected that 70% of people will live in cities by 2050 (United Nation's Human Settlement Program, 2015), we will have a serious problem with urban sprawl reducing our farm land and rural populations, thus reducing our ability to produce the significant quantity of food necessary to sustain our global population.

Agricultural production.

To meet the needs of 9.725 billion people in 2050, we will need to increase our agricultural production by 70% (Alexandratos & Bruinsma, 2012). However, our current rate of consumption far exceeds our current rate of production. This is happening for three reasons: (a) climate change is increasing the frequency and severity of weather resulting in increased loss of crops internationally; (b) soil degradation and desertification is occurring at an alarming rate due to overgrazing, pollution, intensification of agricultural practices; and (c) water is a critical resource, which has been severely mismanaged and continues to become more scarce due to droughts and overconsumption (Brown, 2012). These problems must be addressed to produce healthy, nutritious, and sustainable food, reduce food insecurity, and mitigate the obesity epidemic for our growing population.

Natural resource management.

Natural Resources are finite. While significant issues result from over mining and excessive drilling for minerals, our most pressing challenge with respect to the areas lies with water (Berger & Finkbeiner, 2013; Lui et al. 2015; West et al., 2014). The significant impact of human behavior on climate change has resulted in shifts in the global hydrological cycle (Steffen et al., 2015). This, coupled with the excessive use of ground water and the deterioration of water quality, provide significant issues for our global communities with respect to our most precious resource.

Energy consumption.

The adage we need to increase efficiency and reduce waste is often applied to our global energy challenge, but it is much more complicated than simple efficiency. To meet the needs of our growing global population we will need to triple our energy production by 2050 (Emmott, 2013). Our overreliance on fossil fuels and resistance to alternative energy sources of the past has created a quagmire for our future. This will call for innovative solutions that promote sustainability while validating the profit margins of the large oil, coal, and gas companies.

Climate change.

This is the most significant of the five issues, because it is exacerbated by the proceeding four areas. The rise in greenhouse gas levels have reached a tipping point well beyond irreversibility (Carrington, 2013; Gillis, 2013; Jones, 2013; McCoy, Montgomery, Arulkumaran, & Godlee, 2014; Reichstein, et al., 2013). In addition, the introduction of aerosols into the atmosphere and land use changes (i.e. cutting down forests to create farm land) have quite literally created a perfect storm for us to deal with (Adger, Barnett, Brown, Marshall, & O'Brien, 2013; Hsiang, Burke, & Miguel, 2013). The rapid change in our climate has shifted our weather patterns resulting in larger and more severe storms. This leads to floods, hurricanes, tornados, droughts, and earthquakes that present significant problems for our global communities.

The complex adaptive challenges noted previously are widely represented in the strategic priorities of our most trusted philanthropic organizations globally. Specifically, the United Nations Millennium Development Goals, Gates Foundation Grand Exploration Priorities, White House 21st Century Grand Challenges, and USAID's Grand Challenges all illustrate the urgency of these challenges and the need for interdisciplinary solutions. However, our dynamic and ever-changing global landscape requires innovative solutions that extend beyond traditional ideologies. In the past, technology provided solutions to our most pressing problems. While technology may play a role in the development of solutions that can address these challenges, without massive attitude shifts leading to widespread behavioral change, we will not sustain our global population. This leads us to our final challenge existing as an overarching problem encompassing all of the previously listed issues, public perception.

There is a growing concern by the public regarding food (Caswell, 2012; Rollin, Kennedy, & Wills, 2011), its overall quality (Bawa & Anilakumar, 2013; Frewer et al., 2013), and related health issues (Adler-Milstein, Bates, & Jha, 2013; Nestle, 2013). Consider that the demand for meat is increasing (Allievi, Vinnari, & Luukkanen, 2015), the demand for organic foods is increasing (Lee & Yun, 2015; Niggli, 2015), and concerns about genetically modified organisms (GMOs) continue to mount (Bawa & Anilakumar, 2013; Blancke, Van Breusegem, De Jaeger, Braeckman, & Van Montagu, 2015; Małyska, Maciąg, & Twardowski, 2014; Moschini & Corrigan, 2015). Further, animal welfare is becoming a more prominent fixture in online blogs and traditionally trusted news sources. The People for the Ethical Treatment of Animals (PETA) and other groups are very active in leading campaigns that are influencing the general public, as well as policy. This cannot be ignored as public perception drives the market, and the overwhelming amount of misinformation often drives the public perception. While this appears to be a significant challenge the results of this issue are potentially catastrophic.

The future of our industry relies on our learners. However, our learners are a part of the public and as such, are biased by negative slander campaigns armed with false information. These create the antithesis of what our industry needs to sustain our world. Close-minded and disinterested learners may be apathy and resentment for the agricultural industry lessening their desire to work for these companies. This places a tremendous burden on the agricultural leadership, education, communication, and extension professionals and faculty members asking them to develop the future leaders of the food and agriculture industry from this misguided population. However, through a variety of strategic actions grounded in carefully laid intentions, we have the potential to develop a new kind of learner capable of thinking critically, identifying and removing biases, empowering a shared vision, and most importantly, primed for leadership.

Research Priority Questions

1. What methods, models, and programs are effective in preparing people to solve complex, interdisciplinary problems (e.g. Climate change, food security, sustainability, water conservation, etc.)?
2. How can teaching, research, and extension programs in agricultural leadership, education, and communication address complex interdisciplinary issues (e.g. Climate change, food security, sustainability, water conservation, etc.)?
3. How can formal and nonformal curriculum in Agriculture and Natural Resources address emerging, complex issues (e.g. Climate change, food security, sustainability, water conservation, etc.)?

Overview of the Literature

Creating context.

Agricultural educators who focus on teacher preparation, leadership education, communication effectiveness, and community development through extension are uniquely positioned to address the previously noted suppositions. Specifically, the diversity of the field and the richness of perspectives inherent within it provide a framework for addressing complex problems and adaptive challenges. While significant literature exists regarding the development of competencies within the fields of agriculture and natural resource management (Conner & Roberts, 2013; Conner, Roberts, & Harder, 2013; Harder, Place, & Scheer, 2010; Martone, 2003; Lindner, Dooley, & Wingenbach, 2003), significant gaps exist with respect to how agricultural educators should be developing skills, capacities, dispositions, and competencies in learners within the context of addressing and mitigating complex problems (Boyd & Svejcar, 2009). Concurrently, a gap exists in the literature with respect to detailing the processes, procedures, and programs that provide the greatest benefit for addressing complex problems (Galt, Parr, & Jagannath, 2013). The following provides a snapshot of existing literature, and sets the foundation for expanding research efforts to fill the identified gaps and advance the collective impact of agricultural leadership, education,

communication, and extension on our global communities with respect to the complex problems they face.

Developing capacity for solving complex problems.

Complex adaptive problems can be both identified and clarified by leveraging the perspectives within agricultural education settings. This creates the potential for building capacity in learners who often lack the capacity and/or commitment to address these challenges in a meaningful way. However, leadership training/development programs that seek to simply increase knowledge related to leadership and field-specific expertise (i.e. water resources) are not adequate (Burbach, Floress, & Kaufman, 2015). Learning experiences must be intentionally developed by professionals and faculty members within agricultural leadership, education, communication, and Extension contexts, if they aspire to create foundation for global sustainability.

While "traditional teaching strategies employed throughout modern education history do not offer a method or model with which to conceptualize, much less begin to solve such wicked problems" (Clegorne & Mastrogiovanni, 2015, p. 47), educators can prepare learners to address complex societal through a variety of intentional methodologies. Through the use of innovative methodologies and the development of self-awareness, moral decision-making, and design-thinking, educators can build complex problem solving capacity in learners.

Self-awareness is the foundation for addressing complex problems (Andenoro, Popa, Bletscher, & Albert, 2012; Sowcik, Andenoro, McNutt, & Murphy, 2015) and establishing social change. Social change aimed at mitigating complex problems requires capacity in a variety of areas (Komives & Wagner, 2012). Through social change leadership, learners build capacity for addressing complex problems via a progressive process. The process builds upon individual values, including personal competence and self-awareness, creating a foundation for group values, focused on collaboration and common purpose, and ultimately ending with community development efforts and engaged citizenship (Komives & Wagner, 2012). Though this progressive process, self-awareness is developed through the identification of values, information gathering, exploring alternatives, and analysis of alternatives (Gallagher, 2002). Learners within this learning environment begin to develop capacity for addressing complex problems within group and community contexts (Gallagher, 2002). Understanding of self "creates a foundation for addressing our most complex problems in healthcare and beyond" (Ladhani et al., 2015, p.69).

Educators can use design thinking as a method that provokes students to explore solutions to interdisciplinary problems (Clegorne & Mastrogiovanni, 2015). Further, design thinking provides a method that provokes students to explore solutions to interdisciplinary problems (Clegorne & Mastrogiovanni, 2015). Through design thinking activities educators can have a powerful impact on their learners' ability to address complex problems. "Helping students to think like designers may better prepare them to deal with difficult situations and solve complex problems in school, their careers, and life in general" (Razzouk & Shute, 2012, p. 343). Having good design thinking skills can assist in solving complex problems as well as adjusting to unexpected changes. In addition to this, the design process involves in-depth cognitive processes—which may help students build critical thinking skills (e.g., reasoning and analysis)— it also involves personality and dispositional traits such as persistence and creativity.

In addition to the content developing foundation for self-awareness, self-organizing tendencies, and design-thinking, the context where the learning occurs is also critical. Specifically, experiential learning creates a strong foundation for understanding the complexity and interconnectedness of complex problems (Radke & Chazdon, 2015). Leaners build competence and commitment by understanding complex problems through civic engagement opportunities within adaptive contexts (Radke & Chazdon, 2015). The inclusion of decision-making processes aimed at addressing complex problems in low risk learning environments, provide learners with confidence and competence for addressing complex problems in real world settings outside of learning contexts (Gallagher, 2002). Learners also become predisposed to demonstrating agency for addressing complex problems when presented with authentic challenges within learning contexts (Andenoro, Bigham, & Balser (2014).

Building upon the idea of self-awareness in the decision-making process, it becomes critical to create a moral foundation for addressing the complex problems facing our diverse stakeholders. Grounded in the work of Werhane (1999), moral imagination creates a foundation for enhanced practice and sustainable outcomes (Carroll & Buchholtz, 2014). Further the process of moral imagination pre-disposes the learner to systems thinking (Waddock, 2014) and enhanced accountability (Shepherd, Williams, & Patzelt, 2015) when addressing complex problems. Moral imagination "has the potential to develop resilience and hardiness in organizations and people, which is paramount

for community sustainability" (Odom, Andenoro, Sandlin, & Jones, 2015, p. 130).

While experiential education is not necessarily regarded as an innovative learning methodology, it is critical to adopt innovative instructional strategies to meet the changing needs of learners. Learners within formal and informal learning contexts are changing due to the ever-evolving amount of information that is readily accessible (Kimmerle, Moskaliuk, Oeberst, & Cress, 2015; Tess, 2013). This information far surpasses the amount of knowledge that a traditional agricultural leadership, education, communication, and extension professional or faculty member can provide for the learner. Through the use of inquiry based learning (Levy & Petrulis, 2012; Madhuri, Kantamreddi, & Prakash Goteti, 2012), incisive questioning (Kline, 1999), mindfulness (Gallant, 2016; Roche, Haar, & Luthans, 2014), play (Brown, 2009; Van Hoorn, Nourot, Scales, & Alward, 2014), emotionally engaged thinking (Stedman & Andenoro, 2015), and many other cutting edge techniques, agricultural leadership, education, communication, and extension professionals and faculty members can create a new learning paradigms for our educational environments that engage the newest generation of learners

Addressing & mitigating complex problems.

Through the integration of perspectives from experts in agricultural leadership, education, communication, and extension there are opportunities to see complex adaptive problems for more than a scientific phenomenon requiring technical solutions and create sustainable outcomes for our global communities. The following provides four strategic points that build upon the unique skill set and capacity of colleagues within our field and creates the underpinning for unified approach to addressing our world's most complex challenges. The four priorities also provide a trajectory for necessary research initiatives that assist agricultural leadership, education, communication, and extension professionals and faculty members in creating implications for practically addressing complex problems.

Practice accompaniment and humility.

Collegiality and intentional partnerships are critical for the development of holistic perspectives aimed at addressing complex challenges. However, while this idea serves as the groundwork for the discipline, it often fails to serve as the reality for its practice. The antiquated solutions driven by silos within the agricultural leadership, education, communication, and extension landscape create myopic view points and reduce the holistic perspectives that could lead to sustainable solutions and serve as the bedrock for the interdisciplinary practice. The barriers that prevent solutions are those which maintain the walls between each of the specializations represented by our discipline. Our ability to be exercise empathy, model humility (Morris, Brotheridge, & Urbanski, 2005; Owens, Johnson, & Mitchell, 2013), and practice the idea of accompaniment, where we seek to understand those we are working with and those we are attempting to serve before seeking to be understood and attempting to implement solutions (Andenoro & Bletscher, 2012; Ausland, 2005), will be paramount as we attempt to create the solutions our world needs most. Grant funding initiatives, research projects, teaching teams, and strategic programmatic efforts need to be comprised of representatives from each of the specializations to create holistic solutions and serve interdisciplinary and diverse community based learners. Further, connections among institutions need to be leveraged to develop and implement solutions across geographical boundaries as solutions.

Integrated practice.

Working across our university curriculum to create viable uses for shared data and data mining will become increasingly important in the future to address the complex challenges of our global communities (Kaisler, Armour, Espinosa, & Money, 2013; Wu, Zhu, Wu, & Ding, 2014). These data will become the key basis of competition, productivity trends, innovation, and consumer surplus (Lans, Blok, & Wesselink, 2014). This is critical to understand, as we begin to address the most pressing issues facing Agriculture and Natural Resources. As increasing amount of data are collected there must be a way to create accessible databases that may be shared among university workgroups and institutions (Dalkir, 2013). The ownership of data must be maintained, but it also must be managed by stewards responsible for sharing data to create holistic solutions aimed at diverse populations. By sharing data purposively, we create opportunities to leverage big data and create perspective for how we guide and grow the fields of Agriculture and Natural Resources. Through the careful conversion of big data into narratives conveying understanding for those data, agricultural leadership, education, communication, and extension professionals and faculty members can shift public perceptions and by association change behaviors (Hassanien, Azar, Snasel, Kacprzyk, & Abawajy, 2015; Mayer-Schönberger & Cukier, 2013. This process is critical

to adaptive organizational practice and community development (Conger & Riggio, 2012). Through the integrated practice of agricultural leadership, education, communication, and extension professionals and faculty members and interdisciplinary university faculty we have the potential to develop systems that not only perform data analysis, but then also communicate results in a clear, concise narrative form.

Embrace informal education.

Education must extend beyond the classroom. It will be increasingly important in the future to develop learning contexts outside of the traditional spaces that provide opportunities to engage in problem solving, critical thinking, knowledge building, and contextual understanding to develop the next generation of leaders, adept at addressing the needs of diverse communities (Batsleer, 2015; Sterling, & Huckle, 2014). Through informal education, agricultural leadership, education, communication, and extension professionals and faculty members can develop flexibility for how content is created and consumed by the learner. By reducing the structure and rigidity of formal educational contexts, educators can create content more efficiently and deliver it to learners in a manner which best fits their needs (Batsleer, 2015). Further, we use informal education to achieve greater levels of access through social media and online platforms (Cox, 2013). This creates demand for the innovativeness of the modality and allows learners to engage with the content in a manner that validates their learning style and pace. Ultimately this allows for more adaptable and beneficial learning environment for learners across a broad backdrop of demographic backgrounds (Avraamidou, 2015). Through the use of informal education, agricultural leadership, education, communication, and extension professionals and faculty members have the potential to create well-developed learning opportunities that provide information to learners regardless of time and place. This becomes paramount as we attempt to manage competing priorities and gain an advantage in a dynamic and fast-paced chaotic world (Marsick & Watkins, 2015).

Advance team science.

Agricultural leadership, education, communication, and extension professionals' and faculty members' research progress has been noteworthy given the breadth of practice and faculty expectations for teaching and service. Our ability to frame our discipline, or at least engage in conversations about disciplinary philosophy and content is also important (Baker, 2013a; Miller, 2006). Although certainly far from consensus, researchers have engaged scholars in defining the discipline which has resulted in crucial conversations that must continue (Shinn & Baker, 2010; Shinn, Wingenbach, Briers, Lindner, & Baker, 2009; Shinn, Wingenbach, Lindner, Briers, & Baker, 2009). A cursory look at our publication titles and graduate courses reveals continuous changes that include knowledge management, emotionally-engaged thinking, STEM education, and countless others.

It is also important to remember complex problems are social constructions, agency-based funding priorities change over time, and grant dollars affect disciplinary research agendas (Baker, 2013b). In terms of team science, we must be knowledgeable of the substantive dialogue (both pro and con) on issues by public intellectuals who discuss issues from highly respected publications.

For leadership in team science we must be additive to understanding solutions to the problems (Paxton & Van Stralen, 2015), which goes beyond our typical role in needs assessments, curriculum development, and/or program evaluation (Stedman & Weeks, 2013). We must be informed of the public dialogue (both pro and con) associated with issues, essential behavioral science theory most closely associated with the problems, a fundamental understanding of the integration of the behavioral science and biophysical science approaches, sophistication of research methods that we bring to bear on the problem, as well as an adequate understanding of research methods and outputs others may propose.

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