DETERMINING THE WATER MANAGEMENT INSTRUCTIONAL NEEDS OF TEXAS AGRISCIENCE TEACHERS

By

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"Trust in the Lord with all your heart, and lean not on your own understanding; in all your ways acknowledge Him, and He shall direct your paths."

Proverbs 3:5-6

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Abstract

Dwindling water resources in Texas will not only impact agriculture producers, but all the citizens within the state. Today, there are new technologies to aid in water management, new regulations that determine water usage, as well as the implementation of changes to curriculum (TEKS) in classrooms. With these new technologies it is important for the general public to have a better understanding of what is being done to ensure water for future generations. High school agriscience teachers are an important factor in the future success of the Texas agriculture industry. As one of the early influencers of future industry leaders, agriscience teachers help to shape individual students and the communities in which they teach and reside. Within this changing environment of dwindling water resources, changes in TEKS, and new technologies and regulations, we need to know what instructional support, in terms of materials and training, agriscience teachers need to enhance their instructional efforts and abilities in teaching TEKS-related water management and conservation curriculum in their classrooms.

The purpose of this study was to determine the instructional needs of Texas agriculture science teachers as it pertains to the teaching of agricultural water management and conservation. A population of 658 Texas agriscience teachers was surveyed collecting quantitative data related to the teachers' beliefs, attitudes, and levels of inclusion, confidence, and importance of water-related material in classroom curriculum. Responses were voluntary and yielded a 74% response rate.

Results indicated that agriscience teachers feel content relating to water management and conservation is important, but lack the confidence for full inclusion of the material into the classroom. Agriscience teachers identified instructional materials being used in the classroom along with how they seek out information on water management and conservation. The results will facilitate possible professional development activities for Texas agriscience teachers as well as teaching materials incorporating water management and conservation.

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Chapter I

Introduction

Background Information

Water is the single most important nutrient for life. Though this nutrient is essential for life, only 3% of the available water on Earth can be utilized for human use, the remainder is found in glaciers, oceans, and seas. Texas, along with California, Idaho, and Florida, accounted for more than one-fourth of the total water used in the United States. The majority of daily water used is from groundwater, which is comprised of lakes, rivers, and aquifers. Total water withdrawals, saline and fresh, in the United States in 2005 totaled 410 billion gallons.

Of the fresh water withdraws in Texas during 2005, 33% was accounted for in irrigation purposes. It is crucial to preserve an ample supply of freshwater to support Earth's increasing population (United States Geological Survey, 2009). To ensure the supply of water for the coming generations, it is necessary to educate the public, especially the youth on the current water issues our society is facing.

Water in Texas

"Whiskey is for drinking; water is for fighting" (Mark Twain Quotations, n.d.). For over one hundred years, Texas' Rule of Capture has regulated groundwater usage in the state. The Rule of Capture states "landowners have the right to take all the water they can capture under their land and do with it what they please" (Potter, 2004). The perceived threat that Texas' water resources will fail to meet the long-term needs of the exporting area and the short-term needs of the receiving area is believed throughout the state (Williams, 2011). By 2050, the population of Texas is expected to double, with major urban areas of the state being the bulk of the growth. Increasing pressure, due to growth, on Texas's groundwater supplies will occur from growing demands of urban areas seeking new sources of water (Texas Water Matters, 2011).

Severe drought, diminishing aquifers and groundwater sources statewide, along with extended water usage for agriculture production, are putting areas of Texas at risk of losing their water supply. New regulations being implemented across the state of Texas, to help ensure the future of this natural resource, have caused many agriculture producers to feel their rights to underground water usage (Rule of Capture) are being taken away. Although Texas is the only western state that upholds the Rule of Capture law, organizations assisting in the conservation of natural resources are seeking legislative change. Texas Water Matters, an organization sponsored through the National Wildlife Federation and Sierra Club, is seeking equality in the landowner's right to capture water and the protection of groundwater as a natural resource (2011). Conservation groups believe to ensure that the present and future needs of communities dependent upon groundwater resources are accounted for, the legislature should change the law to balance the landowner's right to capture groundwater with the public interest in managing the resource (Texas Water Matters, 2011).

The 1917 Conservation Amendment allows the Texas Legislature to modify the Rule of Capture law. Since 1917, modifications have been implemented to prevent willful waste, malicious harm to a neighbor, and subsidence (Potter, 2004).

Recommendations have been given to "require that current and future groundwater districts set sustainable-yield caps on pumping and issue permits consistent with those caps" (Texas Water Matters, 2011).

In 1997, the Texas Legislative Session passed Senate Bill 1 to aid in implementing a fifty year plan for water management. Due to the severe droughts in 1995-1996, which affected the Texas economy by $6 million dollars, the Texas Water Development Board (TWDB) and the State Legislature created sixteen planning regions, with accompanying groups, within the state for water plan development (Texas Water Development Board, 2011). In 2005, Texas House Bill 1763 passed which allowed for groundwater to be dealt with through the groundwater conservation districts, within the sixteen groundwater management areas of Texas. Changes which occurred under Bill 1763 are: "(1) regionalizes decisions on groundwater availability, (2) requires regional water planning groups to use groundwater availability numbers from the groundwater conservation districts, and (3) defines a permitting target/cap for groundwater production" (Mace, Petrossian, Bradley, Mullican, & Christian, 2006).

Water districts located in the Texas Panhandle and South Plains are beginning to implement restrictions, which will limit number of acre-inches allotted for irrigation purposes, on producers. "Implementation of water conservation policies could have a noticeable impact on agriculture and the regional economy in the Texas Panhandle" (Guerrero, Wright, Hudson, Johnson, & Amosson, 2010, p. 5). These polices could also have an impact on the state's economy since agriculture is an important industry in many regions of the state, not only to producers, but to public in purchasing goods.

Agricultural Education

"Agricultural Education prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber and natural resources system" (National FFA Organization, n.d.). Agricultural education, also known as agriscience, is the incorporation of science into agriculture. Agriscience programs give youth in public schools the ability to understand the development of products being used, along with an understanding of natural resources, but of the economy and bi-products of agriculture. The Vocational Agriculture Teachers Association of Texas (VATAT), a professional organization of agriculture educators, reports that there are ten areas, fifty-four districts, and 985 chapters/schools with an agriscience program in the state of Texas (n.d.).

Agricultural education has seen a significant change since its inception through the increase in classes taught, as well as the alternative curriculum for instruction and experiences that will better prepare them for future life goals. Courses taught range from food science and technology to metal fabrication and from turf management to advanced animal science. "Agricultural education provides, at a minimum, hands-on, experiential, science and mathematics education that meet the demands for cross-curricular integration, and needs of students in the nontraditional settings" (Dailey, Conroy, & Shelley-Tolbert, 2001). Agricultural education prepares students for a future filled with an understanding of agriculture, agricultural operations, and agriculture business sectors. In order to encourage the future of the agriculture industry, it is important to educate youth, to ensure the growth of this industry in Texas.

With the new regulations being implemented through the State and local water districts, it is important for all citizens to have an understanding of how these laws will affect them. One way to educate the public is by starting in the classroom with youth. A key player in the education of our youth, especially in an area pertaining to natural resources and agriculture, are agriscience teachers.

Texas agriscience teachers are teaching very little in relation to water management and conservation issues (Miller, 2006). A 2006 study by Miller set out to determine West Texas high school agriscience teachers' knowledge, confidence, and attitudes towards teaching water quantity-related topics. Miller found a positive relationship between their knowledge on a topic and the confidence they have in teaching on those topics. Findings showed agriscience teachers had room for improvement based on their perceived knowledge of water related public education. Miller recommended reconstructing the study to include a broader group, to possibly include all agriscience teachers in the state of Texas.

Texas requires the implementation of essential knowledge and skills to be taught in the classroom through the mandated Texas Essential Knowledge and Skills (TEKS) (Texas Education Agency, 2011). Agricultural education has specific TEKS that are created by administrators, teachers, and the Texas Department of Education. Several classes within the Texas public education system have water-related material incorporated into the curriculum, as well as options for students to achieve a secondary science credit.

Changing Curriculum

To ensure the growth of knowledge within the community, it is important to instruct the future generations of our state. Proper instruction is based off of the curriculum recommended or mandated by the state and, or, district. The state of Texas has adopted and implemented the TEKS as its standard curriculum. Through providing leadership, guidance, and resources, the TEKS are utilized to assist schools in meeting all students needs (Texas Education Agency, 2010).

Problem Statement

Dwindling water resources in Texas will not only impact agriculture producers, but all the citizens within the state. Today, there are new technologies to aid in water management, new regulations that determine water usage, as well as the implementation of changes to curriculum (TEKS) in classrooms. With these new technologies it is important for the general public to have a better understanding of what is being done to ensure water for future generations. High school agriscience teachers are an important factor in the future success of the Texas agriculture industry. As one of the early influencers of future industry leaders, agriscience teachers help to shape individual students and the communities in which they teach and reside. Within this changing environment of dwindling water resources, changes in TEKS, and new technologies and regulations, we need to know what instructional support, in terms of materials and training, agriscience teachers need to enhance their instructional efforts and abilities in teaching TEKS-related water management and conservation curriculum in their classrooms.

Purpose and Objectives of the Study

The purpose of this study was to determine the instructional needs of Texas agriscience teachers as it pertains to the teaching of agricultural water management and conservation. The following research objectives are addressed in this study:

1. Describe respondents through demographic variables: age, gender, ethnicity, highest degree received, completed years teaching, students enrolled in the agriscience program, background in agriculture, and water management related experience.
2. Determine the extent of what is currently being taught to students in water management and conservation in terms of content, instructional materials used, and classroom/laboratory activities.
3. Determine current agriscience teacher self-efficacy levels with teaching water management and conservation and their interest levels/motivation (personal and community) in expanding water management and conservation instruction in their school.
4. Determine the instructional materials and resources Texas agriscience teachers use in the classroom.

Definition of Terms

The following are terms and definitions for words that are used in this study:

<u>Agriculture</u>: An applied science that combines principles of the physical, chemical, and biological sciences in the process and production of food and fiber (Merriam-Webster, 2010).

Agriscience: The application of science in agriculture (Malipiedi, 1989). Agricultural educators in Texas refer to themselves as agriscience teachers and their programs as agriscience programs.

Aquifer: A geologic formation that will yield water to a well in sufficient quantities to mate the production of water from this formation feasible for beneficial use; permeable layers of underground rock or sand that hold or transmit groundwater below the water table (Eckhardt, n.d.).

Area I of Texas: VATAT geographic division comprised of school districts located in the following counties: Armstrong, Bailey, Briscoe, Carson, Castro, Childress, Cochran, Collingsworth, Cottle, Crosby, Dallam, Deaf Smith, Dickens, Donley, Floyd, Gray, Hale, Hall, Hansford, Hartley, Hemphill, Hockley, Hutchinson, King, Lamb, Lipscomb, Lubbock, Moore, Motley, Ochiltree, Oldham, Parmer, Potter, Randall, Roberts, Sherman, Swisher, and Wheeler counties in Texas (Texas FFA Association, n.d.).

Area II of Texas: VATAT geographic division comprised of school districts located in the following counties: Andrews, Borden, Brewster, Coke, Crane, Crockett, Culberson, Dawson, Ector, El Paso, Fisher, Gaines, Garza, Glasscock, Haskell, Howard, Hudspeth, Irion, Jeff Davis, Jones, Kent, Loving, Lynn, Martin, Midland, Mitchell, Nolan, Pecos, Presidio, Reagan, Reeves, Schleicher, Scurry, Sterling, Stonewall, Sutton, Terrell, Terry, Tom Green, Upton, Ward, Winkler, and Yoakum counties in Texas (Texas FFA Association, n.d.).

Area IV of Texas: VATAT geographic division comprised of school districts located in the following counties: Archer, Baylor, Brown, Callahan, Clay, Coleman, Comanche, Eastland, Erath, Foard, Hamilton, Hardeman, Jack, Knox, Palo Pinto, Runnels, Shackelford, Stephens, Taylor, Throckmorton, Wichita, Wilbarger, and Young counties in Texas (Texas FFA Association, n.d.).

Area VII of Texas: VATAT geographic division comprised of school districts located in the following counties: Bandera, Bexar, Blanco, Burnet, Caldwell, Comal, Concho, Edwards, Gillespie, Gonzales, Guadalupe, Hays, Kerr, Kimble, Kinney, Lampasas, Llano, Mason, McCulloch, Medina, Menard, Mills, Real, San Saba, Travis, Uvalde, Val Verde, Wilson, and Williamson counties in Texas (Texas FFA Association, n.d.).

Area X of Texas: VATAT geographic division comprised of school districts located in the following counties: Aransas, Atascosa, Bee, Brooks, Calhoun, Cameron, Dewitt, Dimmitt, Duval, Frio, Goliad, Hildago, Jim Hogg, Jim Wells, Karnes, Kenedy, Kleberg, La Salle, Live Oak, Maverick, McMullen, Nueces, Rufugio, San Patricio, Starr, Victoria, Webb, Willacy, Zapata, and Zavala counties in Texas (Texas FFA Association, n.d.).

Attitudes: A mental position with regard to a fact or state (Merriam-Webster, 2010).

Behavior: The response of an individual, group, or species to its environment (Merriam-Webster, 2010).

Beliefs: Conviction of the truth of some statement or the reality of some being or phenomenon especially when based on examination of evidence (Merriam-Webster, 2010).

Confidence: A feeling or consciousness of one's powers or of reliance on one's circumstances; faith or belief that one will act in a right, proper, or effective way (Merriam-Webster, 2010).

Curriculum: A set of courses constituting an area of specialization (Merriam-Webster, 2010).

Domestic Water Use: Water used for indoor household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens (United States Geological Survey, 2005).

Freshwater: Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids (United States Geological Survey, 2005).

Groundwater: Water beneath the earth's surface, often between saturated soil and rock, which supplies water to wells and springs. It is often in the form of an aquifer (Eckhardt, n.d.).

Irrigation Water Use: Water that is applied by an irrigation system to assist crop and pasture growth, or to maintain vegetation on recreational lands such as parks and golf courses (United States Geological Survey, 2005).

Knowledge: The fact or condition of knowing something with familiarity gained through experience or association; acquaintance with or understanding of a science, art, or technique; the fact or condition of being aware of something (Merriam-Webster, 2010).

Livestock Water Use: Water used for livestock watering, feedlots, dairy operations, and other on-farm needs (United States Geological Survey, 2005).

Opinion: A view, judgment, or appraisal formed in the mind about a particular matter; belief stronger than impression and less strong than positive knowledge (Merriam-Webster, 2010).

Public Water Use: Water supplied from a public supplier and used for such purposes as firefighting, street washing, flushing of water lines, and maintaining municipal parks and swimming pools (United States Geological Survey, 2005).

Sprinkler Irrigation System: An irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern (United States Geological Survey, 2005).

Surface Irrigation System: Irrigation by means of flood, furrow, or gravity (United States Geological Survey, 2005).

TEKS: Texas Essential Knowledge and Skills (TEKS) are standards in curriculum set by the state of Texas (Texas Education Agency, 2005; Cox, 2003)

VATAT: The Vocational Agriculture Teachers Association of Texas (VATAT) is a professional organization for agriculture science teachers and supporters of agricultural education. The VATAT is an organization dedicated to member services. The Association informs agriculture teachers about the latest agricultural education practices, encourages higher standards of teaching agriculture and provides agricultural education a unified voice in the state legislature (VATAT, n.d.).

Vocational: Of, relating to, or undergoing training in a skill or trade to be pursued as a career (Merriam-Webster, 2010).

Basic Assumptions

Agriscience teachers from areas one, two, four, seven, and ten attending the 2011 Vocational Agriculture Teachers Association of Texas professional development conference have been chosen for this study with the assumption that the information received will be honest and not intended to deceive the researcher or negatively influence the results of this study. It is also assumed that calculating standard deviations and means are suitable to use since Likert-type scale questions can be considered interval data. Additional assumptions are that all agriscience teachers participating in this study are able to read and comprehend English, and that the knowledge gained by students in the classroom will be shared with their families.

Limitations of the Study

This study is limited to the responses of agriscience teachers who attended the following area meetings: one, two, four, seven, or ten on July 26, 2011 at the Vocational Agriculture Teachers Association of Texas professional development conference in Arlington, Texas. The results of this study do not reflect all Texas agriscience teachers since concerns relating to water management and conservation vary from those found in the semi-arid to arid regions.

Significance of the Study

Water-related issues have been of great importance to the semi-arid to arid regions of Texas due to dwindling water resources and severe drought. Poor public perception of water usage has caused for new rules and regulations to be implemented, especially pertaining to agricultural use. To create a more water conscious public, it is important to educate future generations on this fragile resource since they will be the driving force in decision making of future technologies and regulations. As an important factor in the success of Texas' agriculture industry, agriscience teachers influence students through vocational education, in ensuring their everyday way of life reflects lessons taught. With the current changes in the TEKS, insight is needed as to whether implementation of the curriculum guidelines is occurring, if so, on what level, as well as how confident agriscience teachers are in teaching water-related material in the classroom. Through measuring these levels, their beliefs, and current materials used, researchers will be more efficient in creating future instructional support, training and materials, on water management and conservation to enhance the instructional efforts of agriscience teachers.

Chapter II

Literature Review

Overview

This chapter serves to identify and explain the supporting research which factored into the development of this study pertaining to Texas agriscience teachers. In addition, the literature review will examine teachers' level of confidence in teaching water-related topics, along with the attitude held toward the topic, and instructional materials essential to success in the classroom.

Theoretical Framework

Concerns-Based Adoption Model

The theoretical framework for this study is based on one of the most practical theoretical models for implementation of educational innovations, Hall and Hord's (1987) concerns based adoption model. The concerns based adoption model, which was developed in 1973, describes and explains the course of change experienced by teachers who are attempting to implement new curriculum materials and instructional practices (Anderson, 1997). Three diagnostic tools assist as measures to match resources with the needs of the innovation users (Hall & Hord, 1987). These tools related to the users' stages of concern, level of use, and innovation configuration, allow for better understanding of users and non-users of the applicable innovation. Anderson (1997) also notes that the influence of these tools corresponds with the assumptions on classroom change in curriculum and instruction: (a) change is a process, not an event; (b) change is accomplished by individuals; (c) change is a highly personal experience; (d) change involves developmental growth in feelings and skills; and (e) change can be facilitated by interventions directed toward the individuals, innovations, and contexts involved (Anderson, 1997).

Change facilitators, characterized by Hall and Hord (1987) as teachers, administrators, and other district personnel who, either for a brief or extended period of time, influence the outcome of the educational innovation. The term facilitator, rather than agent, is used to describe the person leading the change, since this person's job is to "assist others in ways relevant to their concerns so that they become more effective and skilled in using new programs and procedures" (Hall & Hord, 1987).

The Concerns-Based Adoption Model (Figure 2.1) treats change as a process, and views the facilitator effective when using "the three dimensions for the concerns-based adoption model to probe individuals and groups in an effort to understand and guide their experiences during the adoption process" (Bellah & Dyer, 2009).

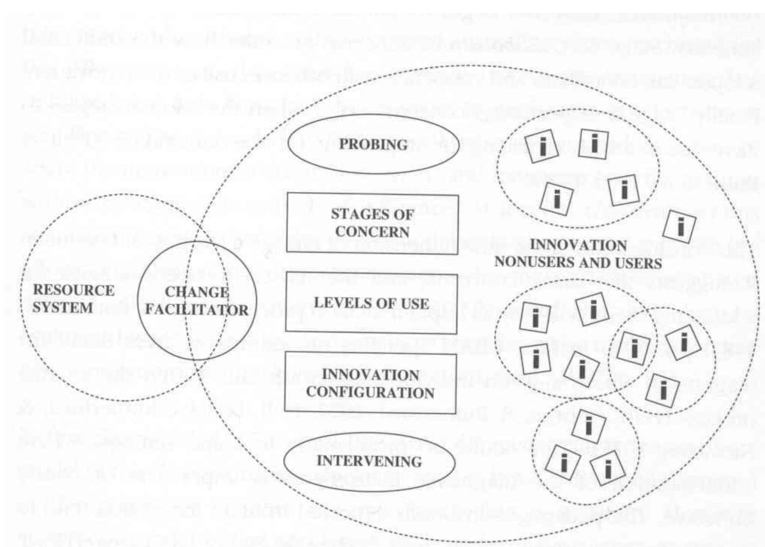

Figure 2.1 Concerns-Based Adoption Model (Hall & Hord, 1987).

An individual's perception of an innovation and how he/she feels about it are addressed throughout the stages of concerns dimension. The concerns-based adoption model's (CBAM) seven stages include awareness, informational, personal, management, consequence, collaboration, and refocusing (Figure 2.2). These stages range on the teacher's involvment, based on minimal concern, knowledge, and understanding, of the benefits of the innovation. "Teachers implementing a change have concerns of varying intensity across all seven stages at different points in the change process" (Anderson, 1997). The CBAM identifies that a person's point of concern may vary from one stage to another. The facilitator's view, as identified in the CBAM, will be influenced based on the viewpoint of the target group (Hall & Hord, 1987).

Figure 2.2 Concerns-Based Adoption Model: Stages of Concern (Hall & Hord, 1987).

What a teacher is doing or not doing in relation to the innovation is addressed in the level of use diminsion. Levels of use focus on "general patterns of teacher behavior as they prepare to use, begin to use, and gain experience implementing a classroom change" (Anderson, 1997). Hall and Hord (1987) recognize eight levels an individual can be classified into based on the extent the innovation is used: (0) nonuse, (I) orientation, (II) preparation, (III) mechanical use, (IV A) routine, (IV B) refinement, (V) integration, and (VI) renewal. To learn about new practices, teachers engage in orientation behaviors, but often everything that is heard or read is not implemented

(Anderson, 1997). Throughout the levels of process, teachers may decide to abandon practices learned for various reasons, some of which are poor curriculum, conflicting priorities, and loss of interest. When the routine level is reached, teachers are implementing new practices, and continue to teach those without revamping the materials being used. Teachers meet the renewal level when implementing new ideas to the materials they have adopted. Motivation of teachers to move from the awareness level onward may be inhibited due to the expectations teachers face on implementing an innovation with only minimal instruction and poor understanding of the topic (Hall & Hord, 1987).

Focusing on the innovation and describing the operational forms it can take is the premise of the innovation configurations (IC) dimension (Hall & Hord, 1987). This dimension was developed from recognizing that the same innovation is rarely implemented in the same exact way (Anderson, 1997). Each teacher has his or her own way to implement an innovation within the classroom, whether it be how the innovation is incorporated in the learning environment, or the level of confidence the teacher has in relation to the innovation. Key behavioral components of change and possible variations in how teachers implement those behavioral components are measured using an IC component checklist. Since different configurations of use are common when multiple teachers implement the same innovation, a pattern of practice details how the innovation is being implemented by each individual teacher (Anderson, 1997).

Conceptual Framework

Water Education

The importance of water education is higher now than it has ever been. With severe drought and diminishing aquifers and groundwater sources statewide, water literacy for our state on water management and conservation has become a major issue for all generations and may be somewhat relieved through an educational strategy (Helfirch & Weigmann, 1990). The fact that every individual is dependent on groundwater every day, not only for water consumption but for food production, creates a higher need for water education (Seacrest & Herpel, 1997). Water literacy is an important key to helping the public have a better understanding and a larger awareness of this natural resource. The necessity for individuals to know and comprehend water facts, have problem solving, observation, classification, and inference skills, and have the motivation to realistic and responsible attitudes about water is crucial to our future water supply (Cox, 2003). "Public understanding of water, water management, and water related issues are basic to solving the present and future water problems" (Cox, 2003, p. 15). Previous water related research has found a general lack of knowledge and misconceptions on water related issues and topics.

The single most important component of public policy needing consideration is water conservation (Sweazy, 1985). Cox (2003) noted that to convince consumers there is a need to conserve underground water, the High Plains Associates (1982) have recommended: (a) research and demonstration projects in water conservation and water-efficient crops, (b) public information, education, extension, and technical assistance programs aimed at both farmers and domestic, municipal, commercial, and industrial water users, (c) research, in planning, development, and the use of technology should increase the quality and quantity of available water, (d) development of alternative energy sources and (e) environmental development opportunities. Though this listing was developed for the High Plains, these topics can easily be adapted to every region in Texas, and should be promoted to help improve agricultural and non-agricultural enterprises.

Kyung-Ok's (2003) *An Inventory for Assessing Environmental Education Curricula* emphasizes that environmental sensitivity is often included in environmental education, and that environmental objectives support environmental sensitivity. Environmental sensitivity can be described as an individuals awareness and attitude toward environmental concepts/topics. Awareness is defined as helping social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems. Kyung-Ok also defined attitude as helping social groups and individuals acquire a set of values and feeling of concern for the environment and motivation for actively participating in environmental improvement and protection. With this, aquifers can be used as a method to help teachers and students better understand relationships between political systems, beliefs, and the value of water as a natural resource.

The study *Development of a Curriculum Framework for Water Education for Educators, Scientists, and Resource Mangers* discussed the curriculum needs of water education (Brody, 1995). Of the research questions Brody focused on, "Are there any differences among different regions of the United States" (p. 9) showed that the level of importance on water-related curriculum can be influenced through regional differences.

“Empirical evidence that exists in the field of water and water resource education a body of knowledge that is distinct from the embodied in tradional education programs” (p. 9) was represented in data throughout the study. The results also focused on factors in water research that helps promote a better understanding on how teaching water-related topics may vary across the country. “The success of environmental education depends on its participation in promoting equity in the general population” (Arcury & Christianson, 1993, p. 19).

In 2003, Cox conducted a study to determine agriscience teachers’ perceived levels of importance and inclusion on water topics, along with information pertaining to the Ogallala Aquifer. Within Cox’s recommendations, three content areas agriscience teachers felt were important, but not included in their current curriculum, were identified as a critical need: water quality research, water contaminatin caused by extraction of petroleum products, and surge irrigation. It was recommended, that through curriculum development and workshops, these three critical needs areas should be addressed. Also, Cox recommended additional research be done in the areas of water management and sustainablility, water information be made available to teachers as additional materals and resources for teaching. Another recommendation was for further research to be conducted on how agriscience teachers teach material in the classroom.

Curriculum Innovation and Implementation

With limited water-related curriculum resources, agriscience instructors are finding difficulty teaching this material (Miller, 2006). Curriculum plays a major role in the educational process and affects most everyone involved in teaching and learning

(Finch & Crunkilton, 1984). By themselves, educative curriculum materials may not lead to successful implementation; administrative support through professional development within the school system is key to successful adoption of curriculum (Bodzin, Kulo, & Peffer, 2011).

Peasely and Henderson (1991) conducted a study of Ohio agriscience teachers to determine level of curriculum inclusion, attitudes, and knowledge level for the implementation of curriculum. The study, *Agriscience Curriculum in Ohio Agricultural Education: Teacher Utilization, Attitudes, and Knowledge*, found that agriscience teachers want curriculum materials to be developed and distributed, as well as guidance in developing curriculum from the Ohio Agricultural Education Service. Also, the study did not support the findings of Rogers and Shoemaker (1971) finding low to negligible relationships between knowledge and education level of agriscience curriculum being taught (Peasley & Henderson, 1991).

Further education, more positive attitudes about change and information sought, opinion leaderhips, risk, science, and further knowledge of innovations, were found by Rogers and Shoemaker (1971) to be positively related to behavior change. Cervero (1982) mentioned for behavioral change to occur, individuals must be motivated to change.

A study by Conroy (1999), part of a larger study by The National Council for Agricultural Education to assess aquaculture education, discussed the adoption of aquaculture curriculum into secondary agriscience. The study sought to understand barriers to including survey, interviews, and focus group discussions. This study found serious barriers that impeded ease of adoption: (a) high cost of remodeling facilities for aquaculture, (b) high cost of equipment to teach aquaculture, and (c) limited facilities to house the program. Another prominent perceived barrier in this study were time constraints and the possibility of increasing the agriscience teachers' workload. Participants agreed there is a large volume of information for aquaculture instruction. "Agricultural educators perceive that the exterior factors of funding, equipment, and teacher knowledge are the largest barriers to adopting integrated science curriculum" (Wilson, Kirby, & Flowers, 2002, p. 78). For the adoption of any curriculum innovation, teachers must have "a true need for it as well as have a sustained commitment for successful implementation" (p. 8). To have a sustained commitment of implementation, teachers must have a perceived true need for the curriculum. If teachers have this need and are able to fill it, it will benefit their students, then they will likely adopt a curriculum innovation.

Agriscience, as defined by Malipiedi (1989), is the application of science in agriculture. Warnick and Thompson (2007) conducted a study comparing and determining perceptions on integrating science into agricultural education programs. Though the concept of agriscience is close to a century old, the concepts have considerably changed due to advancements in both science and agriculture. An effective way to teach science is by integrating science into agriculture curriculum. Successful integration of science and agriculture are held from the perceptions of science teachers (Newman & Johnson, 1993). Effective collaborative efforts among school and state leaders allow for more effectiveness in contextualizing curriculum. Workshops and inservice supporting the integration of science and agriculture should be provided through the State Department of Education and teacher education programs (Warnick & Thompson, 2007).

To assist in the implementation of curriculum changes, professional development workshops are one way of developing awareness among educators. Kiener and Hentschel (1989) conducted a study focusing on learning and workshops. The study found a third of participants recognized the task's complexity could hamper the incorporation process, while the majority of participants found their new knowledge as a facilitator a factor in the incorporation process. Since complexity is an attribute of an innovation, reducing the innovations' complexity can result in the new curriculums increase of implementation.

Agricultural Education Curriculum

Upon realization of the growing need for water education, agricultural extension agents have begun to educate adults about water policy issues, quantity, and quality, as well as ways to conserve and protect natural resources (Cobourn & Donaldson, 1996). This form of education has been modified to a precise application through experiment stations, seminars, hand-on activities, and the classroom settings. In order for agricultural education programs to survive, they must be dynamic and able to adjust to new situations and environments that help to improve on-the-job effectiveness of future graduates (Scanlon, Bruening, & Cordero, 1996; Coorts, 1987; Slocombe & Baugher, 1988).

Developing a farm, home site, entire community, or business site has the potential to teach young people to consider the environmental impacts these outdoor educational settings may have (Mancl & LaBarge, 1996). Extension and the 4-H program offer this education setting in outdoor activities that allow young people to be introduced and expand their current knowledge on nature science through field-based activities. Opportunities within the 4-H program were addressed in a report by the Extension Committee on Organization and Policy on groundwater education. The purpose of this educational program was to present young people with a knowledge of basic water quality principles and to encourage youth to incorporate these principles into nature science, land-use decisions (Mancl & LaBarge, 1996). Mancl and LaBarge noted the Extension Committee on Organization and Policy's report emphasized basic principles of hydrology do not change, even though specific concerns may be different with location and time when developing water quality programs for young people. Teachers who added field trips, along with outside activities to their classroom lessons, found youth were more engaged and successful in the lessons taught (Seacrest & Herpel, 1997). Finch and Crunkilton (1984) suggested the skills and competencies of students are developed through an array of experiences and learning activities.

The information included in the TEKS is derived from standards created by teachers, administrators, and the Texas Department of Education (Texas Education Agency, 2011). Pavelock, Woolery, Ullrich, and Kelley (2008) mentioned courses taught following the TEKS in the agriscience program may also be used for achieving secondary science credits for students. There are several standards that discuss water-related resources within nine classes offered (Figure 2.3).

119.12 Introduction to World Agricultural Science and Technology

- Demonstrate the impacts of agriculture upon land, air, and water resources

119.13 Applied Agricultural Science and Technology

- Identify water conservation methods

119.22 Energy and Environmental Technology

- Determine the importance and scope of natural resources, energy, and environment
- Analyzing conservation and environmental water policies related to the local, state, and national levels
- Identify water and wastewater use and management

119.23 Exploring Aquaculture

- Describe water resource management

119.28 Plant and Animal Production

- Explain the importance of soil and water conservation for future generations

119.46 Wildlife and Recreation Management

- Identify laws and regulations regarding the utilization of wildlife resources
- List factors involved in landowner and property rights

119.47 Range Management and Ecology

- Describe the impact of rangeland on the water cycle and water quality

119.49 Environmental Technology

- Explain the relationship between people, environment, and natural resources
- Explain the use and abuse of natural resources
- Discuss the environmental history, laws, legislation, and regulations

119.83 Agriculture Resources

- Manage natural resources in relationto land, water, and air management
- Develop management skills for natural resources

Figure 2.3 Water-related Texas Essentail Knowledge and Skills (TEKS) for Agriscience Courses (Texas Education Agency, 2011).

Water in Agricultural Education Curriculum

Multiple studies seek to discover methods to extend the lives of aquifers for agricultural purposes (Guerrero et al. 2010). A 2004 study by Cox, Lawver, Baker, and Doerfert focused on water-related curriculum in agricultural education in Ogallala Aquifer-dependent areas. As one of the main water sources that supports a large quantity of agriculture enterprises in the United States, it was essential to conduct a needs assessment to determine the most critical water-related curriculum needs. This study was conducted among agriscience teachers throughout the eight states the Ogallala spans: Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. From the study, the critical needs for water curriculum were water quality research, water contamination caused by extraction of petroleum products, and surge irrigation. Those involved with the research recommended providing the results of the study to educational leaders in each of the Ogallala states. From this, in-service workshops may eventually be developed to address these critical issues.

Miller (2006) took the recommendations from Cox (2003) and focused on determining the water quantity-related attitudes, water-related knowledge, and confidence of teaching water-related issues of West Texas agriscience teachers in Texas FFA Areas I and II. Since there was currently a lack of literature pertaining to water-related topics in the agricultural education field, Miller recommended more curriculum is needed in the areas agriscience teachers feel less knowledgeable. Miller also recommended this could be done through an in-service training.

Jones (2010) performed workshop trainings for Texas agriscience teachers, based on recommendations from Cox and Miller, at the 2009 Vocational Agriculture Teachers Association of Texas conference. This workshop was to determine the effectiveness of using a water management workshop to influence knowledge, beliefs, attitudes, and behaviors of Texas agriscience teachers toward the addition of water-management instruction into their local curriculum. Jones recommended supplying teachers with lesson plans relevant to the content area being taught, as well as material that can be used throughout the school year. Along with furnishing lesson plans to teachers, practicioners should send updated curriculum ideas and reminders to participants throughout the year. Recommendations for future research indicated conducting studies pertaining to the instruction levels of water management and conservation, as well as replicating the workshop to a larger sample. Jones also recommended determining how teachers gather supporting materials and resources needed.

Summary

This review of literature has examined Hall and Hord's Concerns-based Adoption Model (1987) and its relation to curriculum adoption. The review gave insight to this study and related it to similar studies. It revealed a relationship between water education and agricultural education, as well as its implementation. Much research has been conducted involving innovations in education and the development of curriculum. It has been made evident that water issues are ones of which all individuals should be aware. Studies have shown that incorporating water management and conservation into agricultural education curriculum should lead to a better awareness of the importance of this natural resource.

Chapter III

Methodology

Introduction

The purpose of this study was to determine the instructional needs of Texas agriscience science teachers as it pertains to the teaching of agricultural water management and conservation. The following research objectives were addressed in this study:

1. Describe respondents through demographic variables: age, gender, ethnicity, highest degree received, completed years teaching, students enrolled in the agriscience program, background in agriculture, and water management related experience.
2. Determine the extent water management and conservation is being taught in terms of content, instructional materials used, and classroom/laboratory activities.
3. Determine agriscience teachers' current self-efficacy levels with teaching water management and conservation and their interest levels/motivation (personal and community) in expanding water management and conservation instruction in their school.
4. Determine the instructional materials and resources Texas agriscience teachers use in the classroom.

Research Design

This study used descriptive survey research methodologies by way of an in-house survey given to agriscience teachers at the Vocational Agriculture Teachers Association of Texas conference. The study collected and examined data to establish possible relationships between the teachers' knowledge and confidence levels in teaching water management and conservation content, along with their attitudes towards the content relating to water management and conservation.

Multiple types of error are possible when using survey research methods. Non-coverage error, measurement error, non-response error, and sampling error were four types of error Dillman (2007) identified could occur. Efforts to decrease the possibility of error are discussed in this chapter.

The Institutional Review Board (IRB) at Texas Tech University gave the researcher approval to conduct this study.

Population and Sample

The target population for this study was Texas agriscience teachers located in semi-arid and arid regions of Texas attending the Vocational Agriculture Teachers Association of Texas (VATAT) annual conference held in Arlington, Texas from July 25 – 29, 2011. For this study, the target population was defined as secondary agriscience teachers employed in Areas I, II, IV, VII, and X, as represented through the Vocational Agriculture Teachers Association of Texas (VATAT). The accessible population was made up of those teachers who would be in attendance at the annual VATAT Conference.

The five areas represented in the study, which consist of 165 counties, are shown on the Texas FFA Organization map (Figure 3.1).

Figure 3.1. Texas FFA Areas Map (2011)

For this study, the population frame was derived from the Vocational Agriculture Teachers Association of Texas 2010-2011 membership. This membership, based on dues paid to VATAT was composed of 107 agriscience teachers located in 91 schools in Area I (Figure 3.2), 99 agriscience teachers located in 80 schools in Area II (Figure 3.3), 113 agriscience teachers located in 74 schools in Area IV(Figure 3.4), 189 agriscience teachers located in 99 schools in Area VII (Figure 3.5), and 150 agriscience teachers located in 96 schools in Area X (Figure 3.6). Prior to the conference, there was no contact with the agriscience teachers attending the area meeting and participation was voluntary.

Area I			
Abernathy	Floydada	Lubbock Coronado	Shallowater
Adrian	Follett	McLean	Shamrock
Amherst	Frenship	Memphis	Silverton
Anton	Friona	Miami	Slaton
Booker	Ft. Elliott	Monterey	Smyer
Borger	Gruver	Morton	Spearman
Boys Ranch	Guthrie	Motley County	Springlake
Bushland	Hale Center	Muleshoe	Spur
Canadian	Happy	Nazareth	Stratford
Canyon	Hartley	New Deal	Sudan
Caprock	Hedley	Olton	Sunray
Channing	Hereford	Paducah	Tascosa
Childress	Higgins	Pampa	Texline
Clarendon	Highland Park	Panhandle	Tulia
Claude	Idalou	Patton Springs	Valley
Cooper-Lubbock	Kelton	Perryton	Vega
Cotton Center	Kress	Petersburg	Wellington
Crosbyton	Lazbuddie	Plainview	West Texas
Dalhart	Lefors	Ralls	Wheeler
Darrouzett	Levelland	Randall	White Deer
Dimmitt	Littlefield	River Road	Whiteface
Dumas	Lockney	Roosevelt	Whitharral
Farwell	Lorenzo	Ropes	

Figure 3.2. Area I FFA Chapters (2011)

Area II			
Alpine	El Dorado/Socorro	Lamesa	Sands
Andrews	El Paso Coronado	Lee-Midland	Seagraves
Anson	Eldorado	Loop	Seminole
Aspermont	Fort Davis	Loraine	Sierra Blanca
Avoca	Fort Stockton	Marfa	Snyder
Balmorhea	Glasscock County	Meadow	Sonora
Blackwell	Grady	Midland	Southland
Borden	Grape Creek	New Home	Stamford
Bronte	Greenwood	O'Donnell	Stanton
Brownfield	Hamlin	Odessa	Sterling City
Buena Vista	Haskell	Paint Creek	Sweetwater
Canutillo	Hawley	Pecos	Tahoka
Central-San Angelo	Hermleigh	Plains	Tornillo
Christoval	Highland	Post	Veribest
Clint	Ira	Reagan County	Wall
Coahoma	Iraan	Robert Lee	Water Valley
Colorado	Irion	Roby	Wellman-Union
Dawson-Welch	Jayton-Girad	Roscoe	Westbrook
Dell City	Klondike	Rotan	Wilson
Denver City	Lake View	Rule	

Figure 3.3. Area II FFA Chapters (2011)

Area IV			
Abilene	Cross Plains	Jacksboro	Quanah
Albany	Crowell	Jim Ned	Ranger
Archer City	De Leon	Knox City	Rider
Baird	Dublin	Lingleville	Rising Star
Ballinger	Early	May	Santa Anna
Bangs	Eastland	Merkel	Santo
Bellevue	Electra	Midway	Seymour
Blanket	Eula	Miles	Sidney
Breckenridge	Gordon	Mineral Wells	Stephenville
Bryson	Graham	Moran	Strawn
Burkburnett	Gustine	Munday	Throckmorton
Byers	Hamilton	Newcastle	Trent
Chillicothe	Harrold	Northside	Vernon
Cisco	Henrietta	Novice	Windthorst
City View	Hico	Olney	Winters
Clyde	Holliday	Panther Creek	Woodson
Coleman	Huckabay	Perrin	Wylie-Abilene
Comanche	Iowa Park	Petrolia	Zephyr
Cooper-Abilene			

Figure 3.4. Area IV FFA Chapters (2011)

Area VII			
Akins	Eden	Lampasas	Pflugerville
Bandera	Elgin	Lanier	Poth
Bastrop	Florence	Leakey	Priddy
Blanco	Floresville	Leander	Richland Springs
Boerne	Fredericksburg	Lehman	Rochelle
Bowie-Austin	Georgetown	Liberty Hill	Rocksprings
Brackett	Goldthwaite	Llano	Rouse
Brady	Gonzales	Lockhart	Sabinal
Burbank	Granger	Lohn	San Marcos
Burnet	Harper	Lometa	San Saba
Canyon-New Braunfels	Hendrickson	Luling	Sandra Day O’Connor
Canyon Lake	Highlands	Manor	Seguin
Cedar Creek	Hondo	Marble Falls	Smithson Valley
Cedar Park	Hutto	Marion	Smithville
Center Point	Ingram	Mason	Stony Point
Cherokee	Jack C. Hays	McNeil	Taylor
Cibolo Creek	James Madison	Medina	Thomas Jefferson
Clifton Career Center	Jarrell	Medina Valley	Thrall
Comfort	Johnson City	Menard	Tivy
D’Hanis	Judson	Mullin	Utopia
Del Valle	Junction	Natalia	Uvalde
Devine	Knippa	Navarro	Vandergrift
Dripping Springs	La Vernia	New Braunfels	Vista Ridge
East Central	Lago Vista	Nixon-Smiley	Wimberley
East View	Lake Travis	Nueces Canyon	

Figure 3.5. Area VII FFA Chapters (2011)

Area X			
Academy Pride	Edinburg North	Mathis	Runge
Agua Dulce	Falfurrias	McAllen	San Benito
Alice	Falls City	McAllen Memorial	San Diego
Banquete	Freer	Mercedes	San Isidro
Beeville	George West	Mission	San Perlita
Ben Bolt-Palito Blanco	Goliad	Nixon	Santa Maria
Benavides	Gregory-Portland	Nordheim	Santa Rosa
Bishop	Grulla	Odem	Sharyland
Bloomington	H.M. King	Orange Grove	Sinton
Bruni	Harlingen	Palm View	Skidmore-Tyan
Calallen	Harlingen South	Pearsall	Taft
Calhoun	Hebbronville	Pettus	Three Rivers
Carrizo Springs	James Nikki Rowe	Pleasanton	Tilden
Carroll	Jourdanton	Poteet	Tuloso-Midway
Charlotte	Karnes City	Progreso	United
Cotulla	Kenedy	PSJA High	United South
Cuero	La Feria	PSJA Memorial	Veteran Memorial
Dilley	La Joya	Raymondville	Victoria East
Donna	La Villa	Refugio	Victoria West
Dr. Leo Cigarroa	Lopez	Rio Grande City	Weslaco
Eagle Pass	Los Fresnos	Rio Hondo	Yoakum
Edcouch-Elsa	Lyford	Riviera Kaufer	Yorktown
Edinburg	Lytle	Robstown	Zapata
Edinburg Economedes	Martin-Laredo	Roma	

Figure 3.6. Area X FFA Chapters (2011)

The agriscience teachers who did not pay their VATAT membership dues (due July 1, 2011) would not be represented in the population frame. This poses the possibility for frame error within the study. In obtaining the most current list of members and having the agriscience teachers complete the research participation form used for the incentive drawing (included their name, current school, and e-mail), the researcher was able to compare the listing in Figure 3.2 to Figure 3.6 to the collected forms thus reducing the potential threat of frame error. A census was utilized to include the entire accessible population from the five areas resulting in a final frame of 658 Texas agriscience teachers.

Instrumentation

This instrument was developed specifically for this study after the review of existing literature (see Appendix A). The opening section of the instrument was designed to collect data that describes the agriscience teachers' personal beliefs and attitudes about water management and conservation. A six-point Likert-type scale (strongly disagree to strongly agree) was used to determine the respondents' level of agreement with each statement.

The second section examined the teachers' beliefs on other factors that may influence the teaching of water management and conservation in the Texas agriscience classroom. To determine participants' agreement level with each of the thirty-two attitudinal statements, a six-point Likert-type scale (strongly disagree to strongly agree) was developed.

The third section of the instrument examined the water-related Texas Essential Knowledge and Skills (TEKS) for agriculture science and technology programs which included fifteen water-related objectives (Figure 2.3). Within this section, two questions pertaining to each objective were asked. The first question used a five-point Likert-scale (very low importance to very high importance) to determine how important each agriscience teacher thought each water-related TEKS was. The second question used a five-point Likert-type scale (not confident to very confident) to determine the agriscience teachers' confidence level in teaching each of the water-related TEKS.

Using a five-point Likert-type scale, section four questioned agriscience teachers on twenty-five water-related TEKS concepts from three perspectives. For the first question “how important you think the water-related topic is,” agriscience teachers rated the concept’s importance from very low importance to very high. The next question, “the extent the topic is currently included in your curriculum” allowed the agriscience teacher to chose “hardly ever” to “almost always” as their response. For the third question on each of the 25 concepts, agriscience teachers indicated their confidence in teaching that concept using a scale that ranged from “not confident” to “very confident.”

The use of instructional materials and related information sources to teach water management and conservation was the focus for the fifth section of the instrument. Two questions asked participants to select all choices applicable to them: the types of media currently being used in classroom instruction and the method news and information is obtained for their agriscience program. A ranking scale (one = the most used resource) determined the eleven preferences of where agriscience teachers typically obtained these resources. A third question focused on the daily amount of time agriscience teachers spend on preparing instructional material.

Section six focused on agriscience teacher’s experience with water management and conservation. The first question asked how often the participant sought information on water-related issues. Participants were permitted to select all choices that related to them in the following statements: paid agriculture work-related experience prior to teaching and water management related agriculture experiences prior to becoming an agriscience teacher.

Selected personal demographics were collected in the seventh section of the instrument. Information collected included the zip code of the 2010-11 school at which agriscience teachers taught, if the teacher recently moved schools, number of years in the agriculture education profession, number of agriscience teachers employed by their school district, total number of students enrolled in their agriscience program in the 2010-11 school year, age, gender, highest level of education completed, and ethnicity.

The seven-part instrument was designed as a saddle-stitched booklet that measured 8.5 in. x 5.5 in. The front and back covers were printed on a slightly heavier paper than the inside pages with the front cover printed in color to display clearer images. The remaining pages were printed in black and white. The instrument contained three sheets of paper copied two-sided resulting in twelve booklet pages. The inside cover of the instrument contained a letter explaining the need for the study, participants' participation options and rights (including an assurance of confidentiality), how data would be used, and estimated time to complete the survey. The letter was signed prior to duplication by the researcher and the committee chair.

To decrease possible measurement error, the instrument was reviewed by a panel of experts comprised of professors from the Department of Agricultural Education and Communications at Texas Tech University. These experts were selected based on their knowledge pertaining to the survey research process and the subject matter of the instrument. The review process sought to establish face and content validity as well as determine the ease of completing the survey. Following the June 2011 review, suggestions for revisions of the instrument from the panel were evaluated and subsequent changes were made.

A post-hoc test was used to determine the reliability of the instrument. Due to researchers seeking at least a seventy percent response rate, two versions of the instrument, paper and web-based, were administered the population. The paper-based was administered at the VATAT conference and the web-based survey was distributed to agriscience teachers who did not complete the questionnaire at conference. Reliability was calculated for both versions of the instrument. The two instrument versions are identified as early (for paper-based) and late (for web-based) responders, or data set A and data set B, respectively.

Calculated means were used to establish reliability. Cronbach's alpha based on standardized scores is reported in Table 3.1. Overall, 0.58 alpha (early responders) was found for the construct to measure personal beliefs and attitudes about water management and conservation; the alpha for this same construct, late responders, was found to be 0.63 alpha. Reliability for the construct what others think was found to be 0.88 alpha for early responders and 0.75 alpha for late responders. The next construct evaluated the respondents' ability to make desired curriculum changes. Reliability was established for responders at 0.70 alpha. Because there were too few valid cases, late responders was not analyzed. Reliability for how important respondents' think the water-related topic is was found to be 0.97 alpha for early responders and 0.95 for late responders. The reliability for the extent the topic is currently included in the curriculum and the respondents' confidence in teaching the water-related topic were found to be the same among early and late responders. Both constructs had a 0.99 alpha for early responders and a 0.96 alpha for late responders. Overall, the instrument was found to be reliable.

Table 3.1

Reliability and Independent T-Test Describing Early and Late Responders

Constructs	*r*	*M*	*SD*	*t*	*p**
Beliefs and Attidudes					
Early responders	.58	50.37	9.54	-3.04	.002
Late responders	.63	53.66	8.41		
What Others Think					
Early responders	.88	8.07	2.63	-2.54	.011
Late responders	.75	8.89	2.28		
Desired Curriculum Changes					
Early responders	.70	20.76	5.06	11.79	.000
Late responders	N/A[a]	13.75	3.30	15.41	
Importance of Non-TEKS Topics					
Early responders	.97	95.21	25.09	2.09	.037
Late responders	.95	87.23	21.32	2.37	
Inclusion of Non-TEKS Topics					
Early responders	.99	66.28	25.71	1.25	.213
Late responders	.96	61.40	21.55	1.43	
Confidence of Non-TEKS Topics					
Early responders	.99	77.13	26.72	.459	.646
Late responders	.96	75.26	19.22	.593	

Note.[a] Because there were too few cases, this set of data was not analyzed. $p < .05$

Data Collection

Data collection began on Tuesday, July 26, 2011 at the annual Vocational Agriculture Teachers Association of Texas Conference area teacher meetings held in Arlington, Texas. This annual week-long conference is opened to all agriscience teachers in Texas and includes a variety of professional development workshops. Area coordinators were contacted via e-mail two weeks prior to the conference to ensure the researcher would have time during the area business meetings agendas to explain the study, distribute the instrument, and collect the completed instruments.

Since multiple areas and their respective meetings were used in data collection, assistants were used to aid the researcher in distributing the instrument to the various area meeting rooms. The assistants were selected from employees of Texas Tech University attending the conference. A script (see Appendix B) detailing the purpose of the study, the confidentiality agreement, and incentive program was distributed to the assistants, or survey administrators. Prior to distribution of the instrument, the administrator proctored the script and instructed the agriscience teachers to fill out the participation form.

Dillman (2007) noted that an effective measure to increase the response rate is to use a financial incentive. Johnson and McLaughlin (1990) observed sending an incentive or payment after a questionnaire is completed may result in more complete answers (Dillman 2007). Although a negative aspect of incentive inclusion is influencing the completion of the questionnaire, the positive aspects out way the negative. As an incentive for completing the instrument, all agriscience teachers in each area meeting who completed the questionnaire were placed in a drawing for a $50 Visa gift card for each area represented. An additional piece of paper was attached to the instrument for teachers to fill out with their name, school, and e-mail address to be considered for the drawing (see Appendix C). Upon completion of the instrument, agriscience teachers separated the slip and turned in both documents to the instrument administrator. This separation from the instrument helped to ensure the confidentiality of the responses. On August 5, 2011, five agriscience teachers' names were drawn from their respected areas. These teachers were contacted and sent their gift card.

The informational piece of paper filled out for the drawing was also used to compare the names of the respondents with those agriscience teachers names employed in Areas I, II, IV, VII, and X. The teachers who attended the conference, but did not fill out the instrument, were sent a web-based survey through SurveyMonkey asking for their participation. Collecting the informative sheets allowed the researcher to address the potential non-response error. Data collection for this study was completed on October 7, 2011 with a response rate of 75.5% (n = 497). Of the 497 respondents, 405 (81.5%) were from the VATAT conference and the remaining 92 (18.5%) represented the web-based survey. The researcher compared demographics of the two sets of respondents (Table 3.2).

Table 3.2

Description of Early and Late Responders

Demographic	*M*	*SD*	*t*	*p**
Years Teaching Agriculture				
Early responders	11.04	9.36	-3.84	.000
Late responders	16.58	11.03		
Age				
Early responders	36.63	10.42	-4.37	.000
Late responders	43.75	13.21		
Gender				
Early responders	.19	.39	.544	.587
Late responders	.15	.36	.570	
Highest Level of Education				
Early responders	.80	.44	-1.26	.210
Late responders	.98	1.06		
Ethnicity				
Early responders	.14	.44	.693	.488
Late responders	.10	.30	.905	

Note. $p < .05$

Data Analysis Procedure

Participant's responses were coded, entered, and analyzed in to SPSS® version 18 for Windows™ for statistical analysis. Variables were computed in SPSS to determine total scores for the nominal and ordinal summated scale sections. For ordinal and nominal data, measures of central tendencies and frequency distributions summarized the main variables. Correlation techniques were used to analyze the relationships between variables.

Internal Validity

Due to non-response that occurred in the study, there are threats to internal validity. Participants of the sample not completing and returning the survey create a potential non-response error (Dillman et. al, 2009). If agriscience teachers from the accessible population being studied did not attend the VATAT area business meetings where the data was being collected, if they relocated outside of the collected areas, if they chose not to fill out the instrument, or if they have left the profession, the possibility of sampling error could occur. Another potential problem is frame error, which could occur from agriscience membership rosters not being completed from Areas I, II, IV, VII, and X in the VATAT, resulting from teachers that did not pay their annual dues prior to July 1, 2011. Teachers transferring schools, new to teaching, or have just retired also influence the accuracy of the membership roster.

Chapter IV

Findings

Introduction

As stated in Chapter One, the purpose of this study is to determine the instructional needs of Texas agriscience teachers as it pertains to the teaching of agricultural water management and conservation. Following data collection from members of the population, the data was analyzed by SPSS® version 18 for Windows™. Upon analysis, results of findings and relationships between the variables were reported. Included in this chapter are the descriptions of the questionnaire findings which are based on the responses received from the agriscience teachers. To guide this study, research objectives were developed and will be reported in the following order:

1. Describe respondents through demographic variables: age, gender, ethnicity, highest degree received, completed years teaching, students enrolled in the agriscience program, background in agriculture, and water management-related experience.
2. Determine the extent water management and conservation is being taught in terms of content, instructional materials used, and classroom/laboratory activities.
3. Determine agriscience teachers' current self-efficacy levels with teaching water management and conservation and their interest levels/motivation (personal and community) in expanding water management and conservation instruction in their school.

4. Determine the instructional materials and resources Texas agriscience teachers use in the classroom.

A descriptive survey was completed by a total number of 497 people, 405 being paper-based and 92 web-based. Following data collection, the data set was cleaned to remove empty cases and outliers. A final set of cases was analyzed for this study.

Findings for Objective One

Research objective one sought to describe respondents through demographic variables: age, gender, ethnicity, highest degree received, completed years teaching, students enrolled in the agriscience program, background in agriculture, and water management-related experience.

Respondents' years in agricultural education are represented in Table 4.1. More than thirty-five percent (35.9%, *n* = 128) of respondents have taught in the agricultural education profession for less than five years, 20% (*n* = 71) of the agriscience teachers have been teaching for six to ten years, along with 71 teachers (20%) for 21 to 45 years.

Table 4.1

Participants' Years in the Agricultural Education Profession (n = 356)

Years	Frequency	Percent
0 – 5	128	35.9
6 – 10	71	20.0
11 – 20	86	24.1
21 – 45	71	20.0

Note. Mode = 0 – 5 Years.

Respondents' age and gender demographics are displayed in Table 4.2. The age range was 47 years with a minimum of 21 and a maximum of 68. The mean was 37.67 years of age (*SD* = 11.14). The majority of respondents are male (*n* = 308, 81.9%) in comparison to female teachers (*n* = 68, 18.1%).

Table 4.2

Age and Gender of Participating Agriscience Teachers

Characteristic	Frequency	Percent
Age (*n* = 355)		
21 – 30	123	34.6
31 – 40	101	28.5
41 – 50	77	21.7
51 – 60	44	12.4
61 – 70	10	2.8
Gender (*n* = 376)		
Male	308	81.9
Female	68	18.1

Note. Age mode = 21 – 30 years; Gender mode = Male.

A majority of respondents were white (*n* = 329, 87.7%) while the fewest amount of respondents were either African American (*n* = 1, 0.3%) or other ethnicity (*n* = 1, 0.3%). All ethnicity data collection results are represented in Table 4.3.

Table 4.3

Ethnicity of Participating Agriscience Teachers (n = 375)

Ethnicity	Frequency	Percent
White/Caucasian	329	87.7
Hispanic/Latino	44	11.7
Black/African American	1	0.3
Other	1	0.3

Note. Mode = White/Caucasian

The respondents' highest level of education is reported in Table 4.4. Levels of education ranged from a bachelor's degree (*n* = 195, 51.8%) to a doctoral degree (*n* = 2, 0.5%). Most respondents indicated that they have participated in some graduate coursework. The largest amount of respondents (*n* = 195, 51.8%) have received a bachelor's degree.

Table 4.4

Participants' Highest Level of Education (n = 376)

Highest Level of Education	Frequency	Percent
Bachelor's degree	195	51.8
Completed some master's-level	62	16.5
Master's degree	110	29.3
Completed some doctoral-level	7	1.9
Doctoral degree	2	0.5

Note. Mode = Bachelor's degree.

Participants could select more than one answer choice. Out of the 420 respondents who answered the question to their paid agriculture-related work experience prior to teaching, more than half (*n* = 230, 55.5%) selected the choice of farmer while

60.0% (*n* = 252) of the respondents selected the answer choice of rancher. The extension choice was represented least among the respondents with 10.7% (*n* = 45), while almost half (*n* = 170, 40.5%) of respondents selected the answer choice industry. The 77 “other” answers were represented by wildlife management, crop insurance, veterinarian technician, oil and gas, landscaping, grant work, sales, and mechanical. There were 61 (14.5%) respondents who had no paid work experience prior to teaching. Table 4.5 displays the findings related to participants’ paid agriculture-related work experience prior to teaching.

Table 4.5

Participants’ Paid Agriculture-related Work Experience Prior to Teaching (n = 420)

Characteristic	Frequency	Percent
Rancher	252	60.0
Farmer	233	55.5
Industry	176	41.9
No paid work experience	61	14.5
Extension	46	11.0
Other	20	4.8

Note. Respondents were instructed to check all that apply. Other: banker, concrete sales, crop insurance, genetics research, grant proposals, landscape architecture, research assistant, veterinarian technician, welder, wildlife management.

Respondents were allowed to select more than one answer choice. Out of the 404 respondents who answered the choice concerning prior water management experience, 333 (82.4%) had related experience with livestock production, 291 (72.0%) had youth organization experience, 183 (45.3%) had experience with home or lawn experience, 43.1% (*n* = 174) indicated experience with agronomic crop production, 40.8% (*n* = 165) had experience with agriculture irrigation systems, and 17.1% (*n* = 69) had experience with horticulture crop production. Respondents also had *other* water management experiences (n = 8, 1.9%) through soil conservation, environmental research, waste water management, biological studies, and the Texas Alliance for Water Conservation VATAT workshop. Table 4.6 displays the prior water management experience participants held prior to becoming an agriscience teacher.

Table 4.6

Participants' Prior Water Management Experience (n = 404)

Characteristic	Frequency	Percent
Livestock production	333	82.4
Youth organization	291	72.0
Home/lawn irrigation systems	183	45.3
Agronomic crop production	174	43.1
Agriculture irrigation systems	165	40.8
Horticulture crop production	69	17.1
Other	8	1.9

Note. Respondents were instructed to check all that apply. Others: biological studies, environmental research, soil conservation, the Texas Alliance for Water Conservation VATAT workshop, and waste water management.

One hundred eighty-six respondents (44.6%) indicated they access water management and conservation information at least monthly. A small percentage (8.4 %, n = 35) responded they never seek information pertaining to water management and conservation. Table 4.7 displays the respondents' information seeking behavior for water management and conservation.

Table 4.7

Water Management and Conservation Information Seeking Behavior (n = 417)

Information Seeking Frequency	Frequency	Percent
Never	35	8.4
Yearly	63	15.1
More than once a year but less than monthly	133	31.9
Monthly	64	15.3
More than once a month but less than weekly	62	14.9
Weekly	33	7.9
More than once a week but less than daily	17	4.1
Daily	9	2.2
More than once a day	1	0.2

Note. Mode = More than once a year but less than monthly.

Findings for Objective Two

Objective two sought to determine the extent to which water management and conservation is being taught in terms of content, instructional materials used, and classroom/laboratory activities. Means, standard deviations, frequency counts, and valid percentages were calculated to report on this objective.

Current inclusion of water-related curriculum beyond the TEKS was addressed through 25 water-related concepts using Likert-type scales. Agriscience teachers selected their inclusion level in teaching the water-related topic by using the Likert-type scale for extent the topic is currently included in curriculum. Response choices for the inclusion of the water-related topic were as follows: 1 = Hardly Ever, 2 = Occasionally, 3 = Sometimes, 4 = Frequently, and 5 = Almost Always.

Table 4.8 displays the extent the water-related topic is currently included in curriculum. Respondents selected "wildlife management as related to water management practices" (*M* = 3.05, *SD* = 1.10) as the most frequent concept relating to water management and conservation with "accountable/monitoring of agriculture water use" (*M* = 2.65, *SD* = 1.02) being the least included curriculum concept taught. Also reported, "district/regional water laws and policies impacting agriculture water management" (*M* = 2.74, *SD* = 1.11) and "the influence agriculture industry related water policy decisions on water conservation" (*M* = 2.74, *SD* = 1.07) were the concepts pertaining to water policy least included in classroom instruction. Though the two previous concepts were taught little in the classroom, the water policy concept used most in the classroom, "property ownership laws related to water" (*M* = 2.79, *SD* = 1.12), had a mean that was only 0.04 higher than the water policy concepts least used.

Table 4.8
Inclusion Levels of 25 Water-related Topics Not Included in TEKS (n = 497)

			Hardly Ever		Occasionally		Sometimes		Frequently		Almost Always	
Concept	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Wildlife management as related to water management practices. (*n* = 391)	3.05	1.10	37	9.5	80	20.5	135	34.5	105	34.5	34	8.7
Controlling brush growth and development as part of a water management/conservation strategy. (*n* = 390)	3.00	1.12	45	11.5	77	19.7	136	34.9	98	25.1	34	8.7
Alternative farming practices that conserve water. (*n* = 390)	2.97	1.06	43	11.0	75	19.2	142	36.4	109	27.9	21	5.4
Groundwater use in agriculture – practices, issues, and/or trends. (*n* = 421)	2.95	1.02	40	9.5	84	20.0	176	41.8	97	23.0	24	5.7
Creation and use of drought tolerant/water efficient crop varieties in agriculture production. (*n* = 390)	2.93	1.05	44	11.3	79	20.3	150	38.5	96	24.6	21	5.4
Contamination of water sources (surface or groundwater) from agriculture production practices. (*n* = 391)	2.93	1.03	37	9.5	89	22.8	154	39.4	88	22.5	23	5.9
Water demand issues and trends. (*n* = 419)	2.89	1.03	38	9.1	107	25.5	165	39.4	83	19.8	26	6.2
Well water usage – practices, issues, and/or trends. (*n* = 419)	2.87	1.08	53	12.6	93	22.2	154	36.8	95	22.7	24	5.7
Recreational water management practices. (*n* = 389)	2.86	1.12	53	13.6	86	22.1	143	36.8	78	20.1	29	7.5
Drip irrigation system management. (*n* = 389)	2.84	1.10	49	12.6	96	24.7	137	35.2	81	20.8	26	6.7
Monitoring water runoff in agriculture areas. (*n* = 420)	2.84	1.09	55	13.1	92	21.9	168	40.0	74	17.6	31	7.4
Rain water capture methods. (*n* = 420)	2.82	1.17	67	16.0	93	22.1	145	34.5	79	18.8	36	8.6
Soil moisture monitoring – practices and technologies. (*n* = 389)	2.81	1.06	53	13.6	84	21.6	151	38.8	84	21.6	17	4.4
Property ownership laws related to water. (*n* = 392)	2.79	1.12	61	15.6	89	22.7	138	35.2	81	20.7	23	5.9
Flood/Furrow irrigation system management. (*n* = 386)	2.78	1.09	56	14.5	93	24.1	135	35.0	84	21.8	18	4.7

Table 4.8 Continued
Inclusion Levels of 25 Water-related Topics Not Included in TEKS (n = 497)

			Hardly Ever		Occasionally		Sometimes		Frequently		Almost Always	
Concept	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
State water laws and policies impacting agriculture water management. (*n* = 391)	2.78	1.09	59	15.1	88	22.5	145	37.1	78	19.9	21	5.4
The influence public related water policy decisions on agriculture water use. (*n* = 390)	2.77	1.08	62	15.9	81	20.8	151	38.7	78	20.0	18	4.6
District/Regional water laws and policies impacting agriculture water management. (*n* = 391)	2.74	1.11	65	16.6	88	22.5	142	36.3	76	19.4	20	5.1
Use of rivers for irrigation purposes. (*n* = 388)	2.74	1.09	61	15.7	88	22.7	147	37.9	73	18.8	19	4.9
Pivot irrigation system management. (*n* = 388)	2.74	1.09	59	15.2	92	23.7	149	38.4	66	17.0	22	5.7
Accountable/monitoring of household water use. (*n* = 416)	2.74	1.08	56	13.5	117	28.1	151	36.3	64	15.4	28	6.7
The influence agriculture industry related water policy decisions on water conservation. (*n* = 392)	2.74	1.07	61	12.3	90	18.1	148	29.8	76	15.3	17	3.4
Water recharge trends and research. (*n* = 420)	2.70	1.02	55	13.1	115	27.4	168	40.0	64	15.2	18	4.3
Industrial usage of water – practices, issues, and/or trends. (*n* = 420)	2.68	1.06	67	16.0	105	25.0	165	39.3	63	15.0	20	4.8
Accountable/monitoring of agriculture water use. (*n* = 422)	2.65	1.02	60	14.2	118	28.0	172	40.8	53	12.6	19	4.5

Note. Hardly Ever = 1; Occasionally = 2; Sometimes = 3; Frequently = 4; Almost Always = 5.

Instructional materials are a crucial part of the agriscience teachers' classroom. Multiple forms of media were used within their classroom instruction. Table 4.9 displays the types of media currently being used in the respondents' classroom. As noted, respondents could check multiple answers, since the ideal classroom instructor uses multiple formats of instruction to reach all learning styles. The most used type of media is videos in physical format (DVD/VHS) with 360 (87.8%), with curriculum kits following closely behind with 354 (86.3%), 76.3% (*n* = 313) of respondents used textbooks in print format, while only 32.4% (*n* = 133) used textbooks in the digital format. Respondents used websites, or the Internet, for print content and/or lessons (*n* = 306, 74.6%) more than for video or image content (*n* = 231, 56.3%). Other forms of media, 0.6% (*n* = 3) were represented by organizational handouts.

Table 4.9

Types of Media Currently Used in Participants' Classrooms (n = 410)

Types of Media	Frequency	Percent
Videos in physical format (DVD/VHS)	360	87.8
Curriculum kits	354	86.3
Textbooks – print format	313	76.3
Websites/Internet for print content and/or lessons	306	74.6
Magazines	265	64.6
Websites/Internet for video/image content	231	56.3
Newspapers	159	38.8
Textbooks – digital format	133	32.4
Other media types	3	0.6

Note. Mode = Videos in physical format (DVD/VHS). Respondents could check multiple answers. As such, percentages do not equal 100%.

Table 4.10 reports how participants typically obtain the news and information they would use in their agriscience program. As noted, respondents could select multiple answers. The news and information source most frequently used is the internet (*n* = 374, 91.7%), 305 (74.8%) respondents used agriculture-focused magazines and journals, and 52.7% (*n* = 215) used personal sources as a resource. Only 82 (20.1%) respondents used social media technology as a resource for news and information, which is interesting due to society, as well as students' preferred method of communication.

Table 4.10

Methods Participants' Use in Obtaining News and Information (n = 408)

News and Information Sources	Frequency	Percent
Internet	374	91.7
Agriculture-focused magazines and journals	305	74.8
Personal Sources	215	52.7
Newsletters from agriculture-related organizations (*n* = 407)	210	51.6
Newspaper (print or electronic)	198	48.5
Education/teaching-focused magazines and journals	179	43.9
Local TV Channels	177	43.4
Satellite/cable TV channel	162	39.7
Radio	130	31.9
Social media technology	82	20.1
Non-agriculture magazines and	81	19.9
Other source	2	0.4

Note. Mode = Internet. Respondents could check multiple answers; percentages do not equal 100%.

Findings for Objective Three

Objective three sought to determine Texas agriscience teachers' current self-efficacy levels with teaching water management and conservation and their interest levels/motivation (personal and community) in expanding water management and conservation instruction in their school. Means, standard deviations, frequency counts, and valid percentages were calculated to report on this objective.

Table 4.11 displays participants' responses on a six-point Likert-type scale (1 = strongly disagree, 6 = strongly agree) of their personal beliefs and attitudes on water management and conservation. The statement "it is important for the community/state to have reliable and effective water management operations" had the highest mean (M = 5.55, SD = 0.91) while "if there was a water shortage in my area, my quality of life would remain stable" had the lowest mean (M = 2.76, SD = 1.57) of all statements.

Table 4.11

Participant's Beliefs and Attitudes about Water Management and Conservation (n = 497)

			Strongly Agree		Agree		Slightly Agree		Slightly Disagree		Disagree		Strongly Disagree	
Statement	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
It is important for the community/state to have reliable and effective water management operations. (*n* = 495)	5.55	0.91	337	68.1	133	26.9	10	2.0	2	0.4	1	0.2	12	2.4
It is important to teach our youth on water management and conservation. (*n* = 487)	5.37	0.75	238	48.9	211	43.3	25	5.1	8	1.6	5	1.0	0	0.0
Water management will become more costly over the next five years. (*n* = 487)	5.26	0.83	211	43.3	219	45.0	40	8.2	11	2.3	3	0.6	3	0.6
Groundwater research is important to future generations. (*n* = 484)	5.25	0.80	202	41.7	222	45.9	47	9.7	9	1.9	1	0.2	3	0.6
Texas is at risk of significant water shortages in the next 25 – 50 years. (*n* = 493)	5.19	0.98	237	48.1	155	31.4	76	15.4	15	3.0	6	1.2	4	0.8
I believe that agriscience teachers should be teaching about water management and conservation. (*n* = 486)	5.16	0.74	167	34.4	240	49.4	70	14.4	8	1.6	1	0.2	0	0.0
It is important to have a written set of principles and guidelines related to water management. (*n* = 495)	5.10	0.83	151	30.5	274	55.4	53	10.7	9	1.8	3	0.6	5	1.0
Besides human consumption, the most important use of our water resources is for agriculture production and processing. (*n* = 490)	5.06	0.94	172	35.1	225	45.9	64	13.1	16	3.3	10	2.0	3	0.6
Texas is at risk of significant water shortages in the next 5 – 10 years. (*n* = 485)	5.04	0.96	180	37.1	189	39.0	85	17.5	20	4.1	10	2.1	1	0.2
I should be including more water management and conservation content in my curriculum. (*n* = 491)	4.82	0.84	97	19.8	240	48.9	134	27.3	12	2.4	7	1.4	1	0.2
Water related education is of little importance for the general public. (*n* = 490)	4.66	1.57	197	40.2	146	29.8	41	8.4	23	4.7	56	11.4	27	5.5
Production agriculture could improve its water management practices to conserve more water. (*n* = 486)	4.56	0.88	55	11.3	222	45.7	162	33.3	35	7.2	11	2.3	1	0.2
New water management technologies are our best hope to reduce water use on farms and ranches. (*n* = 485)	4.54	1.02	61	12.6	229	47.2	142	29.3	27	5.6	18	3.7	8	1.6
Farmers do too little to conserve water. (*n* = 490)	4.47	1.30	117	23.9	162	33.1	104	21.2	67	13.7	23	4.7	17	3.5

Table 4.11 Continued

Participant's Beliefs and Attitudes about Water Management and Conservation (n = 497)

			Strongly Agree		Agree		Slightly Agree		Slightly Disagree		Disagree		Strongly Disagree	
Statement	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
There is too much water usage with agriculture. (*n* = 487)	4.28	1.31	83	17.0	176	36.1	91	18.7	81	16.6	44	9.0	12	2.5
The challenges with water management are the same as they were five years ago. (*n* = 494)	3.97	1.51	66	13.4	178	36.0	74	15.0	58	11.7	88	17.8	30	6.1
The community I live in uses too much water. (*n* = 487)	3.59	1.33	39	8.0	93	19.1	124	25.5	109	22.4	104	21.4	18	3.7
Water management by farmers and ranchers needs to be regulated if water use is to be reduced. (*n* = 489)	3.54	1.35	24	4.9	106	21.7	146	29.9	90	18.4	80	16.4	43	8.8
If there was a water shortage in my area, my quality of life would remain stable. (*n* = 488)	2.76	1.54	38	7.8	49	10.0	55	11.3	64	13.1	179	36.7	103	21.1

Note. Strongly Disagree = 1; Disagree = 2; Slightly Disagree = 3; Slightly Agree = 4; Agree = 5; Strongly Agree = 6

Other factors that may influence the teaching of water management and conservation in the Texas agriscience classroom were represented in categories, "What others think and ability to make desired curriculum changes." Table 4.12 displays participants' responses on a six-point Likert-type scale (1 = strongly disagree, 6 = strongly agree) of what others think along with participants' ability to make desired curriculum changes. The statement "most people important in my life would think that water management and conservation are important" (M = 5.12, SD = 0.75) had the highest mean for what others think. "I feel my students could use a better understanding of water management and conservation" (M = 5.07, SD = 0.63) reported the highest mean or ability to make desired curriculum changes.

Table 4.12

Other Factors That May Influence Participants' Teaching of Water Management and Conservation (n = 497)

Statement	*M*	*SD*	Strongly Agree *f*	Strongly Agree %	Agree *f*	Agree %	Slightly Agree *f*	Slightly Agree %	Slightly Disagree *f*	Slightly Disagree %	Disagree *f*	Disagree %	Strongly Disagree *f*	Strongly Disagree %
What Others Think														
Most people important in my life would think that water management and conservation are important. (*n* = 451)	5.12	0.75	136	30.2	253	54.1	47	10.4	12	2.7	3	0.7	0	0.0
Other agriscience teachers with who I am acquainted would think that water management and conservation are important. (*n* = 449)	5.11	0.68	119	26.5	274	61.0	45	10.0	10	2.2	1	0.2	0	0.0
Most people important in my life would think that I should include water management and conservation in my curriculum. (*n* = 450)	4.79	0.81	73	16.2	240	53.3	113	25.1	17	3.8	7	1.6	0	0.0
Other agriscience teachers who I am acquainted would think that I should include water management and conservation in my curriculum. (*n* = 449)	4.73	0.82	61	13.6	244	54.3	114	25.4	23	5.1	7	1.6	0	0.0
Ability to Make Desired Curriculum Changes														
I feel my students could use a better understanding of water management and conservation. (*n* = 451)	5.07	0.63	106	23.5	272	60.3	72	16.0	1	0.2	0	0.0	0	0.0
Within my program, I could include water management and conservation if I wanted to. (*n* = 447)	4.99	0.75	105	23.5	251	56.2	77	17.2	11	2.5	3	0.7	0	0.0
I believe I could include water management and conservation in my curriculum. (*n* = 451)	4.98	0.71	90	20.0	275	61.0	76	16.9	5	1.1	5	1.1	0	0.0
My principal is supportive of my program. (*n* = 448)	4.89	1.10	136	30.4	196	43.8	79	17.6	15	3.3	12	2.7	10	2.2

Table 4.12 Continued

Other Factors That May Influence Participants' Teaching of Water Management and Conservation (n = 497)

Statement	*M*	*SD*	Strongly Agree *f*	Strongly Agree %	Agree *f*	Agree %	Slightly Agree *f*	Slightly Agree %	Slightly Disagree *f*	Slightly Disagree %	Disagree *f*	Disagree %	Strongly Disagree *f*	Strongly Disagree %
Ability to Make Desired Curriculum Changes														
My superintendent is supportive of my program. (*n* = 442)	4.87	1.09	137	31.0	180	40.7	84	19.0	21	4.8	13	2.9	7	1.6
I have complete control over what I teach, thus I could include water management and conservation. (*n* = 372)	4.71	0.99	78	21.0	158	42.5	98	26.3	27	7.3	9	2.4	2	0.5
My administration does not require me to teach on water management and conservation. (*n* = 366)	4.70	1.00	63	17.2	186	50.8	81	22.1	19	5.2	13	3.6	4	1.1
Teaching water management and conservation would be compatible in all my classes. (*n* = 451)	4.46	1.05	61	13.5	184	40.8	138	30.6	42	9.3	22	4.9	4	0.9
My administration expects me to teach on water management and conservation. (*n* = 363)	3.19	1.39	18	5.0	62	17.1	64	17.6	80	22.0	106	29.2	33	9.1

Note. Strongly Disagree = 1; Disagree = 2; Slightly Disagree = 3; Slightly Agree = 4; Agree = 5; Strongly Agree = 6.

A set of 15 statements pertaining to specified Texas Essential Knowledge and Skills (TEKS) were considered by the agriscience teachers using a Likert-type scale to reflect their confidence and perceived importance of the statement. The Likert-type scale for confidence in teaching water-related TEKS was as follows: 1 = Not Confident, 2 = Little Confidence, 3 = Somewhat Confident, 4 = Confident, and 5 = Very Confident. The Likert-type scale for how important agriscience teachers think water-related TEKS is was as follows: 1 = Very Low Importance, 2 = Low Importance, 3 = Moderate Importance, 4 = High Importance, and 5 = Very High Importance.

Table 4.13 displays the importance levels agriscience teachers had for each TEKS statement. Agriscience teachers felt the objective "explain the importance of soil and water conservation for future generations" (*M* = 4.24, *SD* = 0.76) was of greater importance to teach. Although the means to all TEKS were relatively similar in range, the TEKS objective "discuss the environmental history, laws, legislation, and regulations" was considered of lesser importance (*M* = 3.91, *SD* = 0.86) of the remaining objectives.

Agriscience teachers' confidence levels in teaching water-related TEKS statements are reported in Table 4.14. Confidence levels were extremely close in showing agriscience teachers were uncomfortable with the TEKS. "Discuss the environmental history, laws, legislation, and regulations" was the statement agriscience teachers had least confidence in teaching (*M* = 3.35, *SD* = 1.05) with "analyze conservation and environmental policies related to local, state, and national levels" (*M* = 3.36, *SD* = 1.00) following closely behind. The TEKS statement that agriscience teachers felt they had most confidence in was “explain the importance of soil and water conservation for future generations” (M = 3.78, SD = 0.91), although the mean for this objective is only 0.43 higher than the objective of least confidence.

The mean weighted discrepancy score (MWDS) is displayed in Table 4.15, along with the mean and standard deviations for the perceived importance and confidence levels in relation to the water-related TEKS objectives. Though there is no standard for interpreting the MWDS, the scores are ranked from the greatest to the least need (McKim & Saucier, 2011).

Table 4.13

Respondents' Perceived Importance of Water-related TEKS Objectives (n = 497)

Objective	*M*	*SD*	Very Low Importance *f*	%	Low Importance *f*	%	Moderate Importance *f*	%	High Importance *f*	%	Very High Importance *f*	%
119.12 Introduction to World Agricultural Science and Technology												
Demonstrate the impacts of agriculture upon land, air, and water resources. (*n* = 436)	4.12	0.79	0	0.0	5	1.1	98	22.5	173	39.7	160	32.2
119.13 Applied Agricultural Science and Technology												
Identify water conservation methods. (*n* = 435)	4.14	0.82	0	0.0	9	2.1	92	21.1	161	37.0	173	39.8
119.22 Energy and Environmental Technology												
Determine the importance and scope of natural resources, energy, and environment. (*n* = 433)	4.08	0.76	0	0.0	5	1.2	95	21.9	193	44.6	140	32.3
Identify water and wastewater use and management. (*n* = 430)	4.07	0.81	0	0.0	10	2.3	96	22.3	180	41.9	114	33.5
Analyze conservation and environmental policies related to local, state, and national levels. (*n* = 431)	3.93	0.80	0	0.0	13	3.0	115	26.7	193	44.8	110	25.5
119.23 Exploring Agriculture												
Describe water resource management. (*n* = 424)	4.05	0.85	1	0.2	11	2.6	103	24.3	158	37.3	151	35.6
119.28 Plant and Animal Production												
Explain the importance of soil and water conservation for future generations. (*n* = 448)	4.24	0.76	0	0.0	4	0.9	78	17.4	174	38.8	192	42.9

Table 4.13 Continued

Respondents' Perceived Importance of Water-related TEKS Objectives (n = 497)

Objective	*M*	*SD*	Very Low Importance *f*	%	Low Importance *f*	%	Moderate Importance *f*	%	High Importance *f*	%	Very High Importance *f*	%
119.46 Wildlife and Recreation Management												
Identify laws and regulations regarding the utilization of wildlife resources. (*n* = 448)	4.08	0.80	1	0.2	8	1.8	97	21.7	188	42.0	154	34.4
List factors involved in landowner and property rights. (*n* = 443)	4.04	0.82	1	0.2	9	2.0	107	24.2	179	40.4	147	33.2
119.47 Range Management and Ecology												
Describe the impact of rangeland on the water cycle and water quality. (*n* = 446)	4.11	0.77	1	0.2	4	0.9	91	20.4	199	44.6	151	33.9
119.49 Environmental Technology												
Explain the use and abuse of natural resources. (*n* = 447)	4.11	0.80	0	0.0	8	1.8	95	21.3	184	41.2	160	35.8
Explain the relationship between people, environment, and natural resources. (*n* = 447)	4.07	0.81	3	0.7	4	0.9	104	23.3	185	41.4	151	33.8
Discuss the environmental history, laws, legislation, and regulations. (*n* = 446)	3.91	0.86	5	1.1	11	2.5	125	28.0	183	41.0	122	27.4
119.83 Agriculture Resources												
Manage natural resources in relation to land, water, and air management. (*n* = 445)	4.06	0.78	0	0.0	7	1.6	102	22.9	195	43.8	141	31.7
Develop management skills for natural resources. (*n* = 446)	4.02	0.78	1	0.2	3	0.7	114	25.6	195	43.7	133	29.8

Note. Very Low Importance = 1; Low Importance = 2; Moderate Importance = 3; High Importance = 4; Very High Importance = 5.

Table 4.14
Respondents' Confidence Level in Teaching the Water-related TEKS Objectives (n = 497)

Objective	*M*	*SD*	Not Confident *f*	Not Confident %	Little Confidence *f*	Little Confidence %	Somewhat Confident *f*	Somewhat Confident %	Confident *f*	Confident %	Very Confident *f*	Very Confident %
119.12 Introduction to World Agricultural Science and Technology												
Demonstrate the impacts of agriculture upon land, air, and water resources. (*n* = 434)	3.70	0.95	8	1.8	30	6.9	140	32.3	161	37.1	95	21.9
119.13 Applied Agricultural Science and Technology												
Identify water conservation methods. (*n* = 434)	3.72	0.92	9	2.1	20	4.6	149	34.3	162	37.3	94	21.7
119.22 Energy and Environmental Technology												
Determine the importance and scope of natural resources, energy, and environment. (*n* = 431)	3.60	0.95	11	2.6	29	6.7	164	38.1	146	33.9	81	18.8
Identify water and wastewater use and management. (*n* = 429)	3.52	0.96	10	2.3	38	8.9	177	41.3	128	29.8	76	17.7
Analyze conservation and environmental policies related to local, state, and national levels. (*n* = 431)	3.36	1.00	19	4.4	44	10.2	189	43.9	119	27.6	60	13.9
119.23 Exploring Agriculture												
Describe water resource management. (*n* = 428)	3.51	0.98	11	2.6	41	9.6	170	39.7	129	30.1	77	18.0
119.28 Plant and Animal Production												
Explain the importance of soil and water conservation for future generations. (*n* = 450)	3.78	0.91	7	1.6	21	4.7	141	31.3	178	39.6	103	22.9
119.46 Wildlife and Recreation Management												
Identify laws and regulations regarding the utilization of wildlife resources. (*n* = 450)	3.60	1.04	17	3.8	37	8.2	157	34.9	137	30.4	102	22.7
List factors involved in landowner and property rights. (*n* = 443)	3.50	1.00	19	4.3	35	7.9	170	38.4	144	32.5	75	16.9

Table 4.14 Continued

Respondents' Confidence Level in Teaching the Water-related TEKS Objectives (n = 497)

			Not Confident		Little Confidence		Somewhat Confident		Confident		Very Confident	
Objective	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
119.47 Range Management and Ecology												
Describe the impact of rangeland on the water cycle and water quality. (*n* = 446)	3.60	0.96	13	2.9	29	6.5	166	37.2	155	34.8	83	18.6
119.49 Environmental Technology												
Explain the relationship between people, environment, and natural resources. (*n* = 446)	3.67	0.93	8	1.8	27	6.1	162	36.3	157	35.2	92	20.6
Explain the use and abuse of natural resources. (*n* = 445)	3.67	0.89	6	1.3	23	5.2	165	37.1	167	37.5	84	18.9
Discuss the environmental history, laws, legislation, and regulations. (*n* = 446)	3.35	1.05	25	5.6	48	10.8	190	42.6	111	24.9	72	16.1
119.83 Agriculture Resources												
Manage natural resources in relation to land, water, and air management. (*n* = 444)	3.63	0.91	8	1.8	28	6.3	165	37.2	163	36.7	80	18.0
Develop management skills for natural resources. (*n* = 442)	3.57	0.91	9	2.0	29	6.6	181	41.0	145	32.8	78	17.6

Note. Not Confident = 1; Little Confidence = 2; Somewhat Confident = 3; Confident = 4; Very Confident = 5.

Table 4.15

Respondents' Mean Weighted Discrepancy Score Pertaining to Water-related TEKS Objectives

		Importance		Confidence	
Objectives	MWDS	*M*	*SD*	*M*	*SD*
Analyze conservation and environmental policies related to local, state, and national levels (119.22 Energy and Environmental Technology). *n* = 431	2.21	3.93	0.80	3.36	1.00
Identify water and wastewater use and management (119.22 Energy and Environmental Technology). *n* = 430	2.26	4.07	0.81	3.52	0.96
List factors involved in landowner and property rights (119.46 Wildlife and Recreation Management). *n* = 443	2.20	4.04	0.82	3.50	1.00
Discuss the environmental history, laws, legislation, and regulations (119.49 Environmental Technology). *n* = 446	2.18	3.91	0.86	3.35	1.05
Describe the impact of rangeland on the water cycle and water quality (119.47 Range Management and Ecology). *n* = 446	2.11	4.11	0.77	3.60	0.96
Describe water resource management (119.23 Exploring Agriculture). *n* = 424	2.06	4.05	0.85	3.51	0.98
Determine the importance and scope of natural resources, energy, and environment (119.22 Energy and Environmental Technology). *n* = 433	2.05	4.08	0.76	3.60	0.95
Explain the relationship between people, environment, and natural resources (119.49 Environmental Technology). *n* = 447	1.95	4.07	0.81	3.67	0.93
Develop management skills for natural resources (119.83 Agriculture Resources). *n* = 446	1.93	4.02	0.78	3.57	0.91
Identify laws and regulations regarding the utilization of wildlife resources (119.46 Wildlife and Recreation Management). *n* = 448	1.91	4.08	0.80	3.60	1.04
Explain the importance of soil and water conservation for future generations (119.28 Plant and Animal Production). *n* = 448	1.88	4.24	0.76	3.78	0.91
Explain the use and abuse of natural resources (119.49 Environmental Technology). *n* = 447	1.86	4.11	0.80	3.67	0.89
Identify water conservation methods (119.13 Applied Agricultural Science and Technology). *n* = 435	1.80	4.14	0.82	3.72	0.92
Demonstrate the impacts of agriculture upon land, air, and water resources (119.12 Introduction to World Agricultural Science and Technology). *n* = 436	1.79	4.12	0.79	3.70	0.95
Manage natural resources in relation to land, water, and air management (119.83 Agriculture Resources). *n* = 445	1.77	4.06	0.78	3.63	0.91

Note. Not Confident = 1; Little Confidence = 2; Somewhat Confident = 3; Confident = 4; Very Confident = 5. Very Low Importance = 1; Low Importance = 2; Moderate Importance = 3; High Importance = 4; Very High Importance = 5.

Importance of water-related curriculum and confidence in teaching water-related topics beyond the TEKS was addressed through 25 water-related concepts using Likert-type scales. Agriscience teachers selected their confidence level in teaching the water-related topic and how important they think the water related topic is. The Likert-type scale for confidence in teaching water-related topic was as follows: 1 = Not Confident, 2 = Little Confidence, 3 = Somewhat Confident, 4 = Confident, and 5 = Very Confident. The Likert-type scale: 1 = Very Low Importance, 2 = Low Importance, 3 = Moderate Importance, 4 = High Importance, and 5 = Very High Importance reflected the teacher's thoughts on the importance of water-related topic.

Table 4.16 displays the importance levels for each water-related topic. Agriscience teachers felt the concept "creation and use of drought tolerant/water efficient crop varieties in agriculture" (M = 4.20, SD = 0.82) was of greater importance to include in classroom instruction. Although the means to all objectives were relatively similar in range, the water-related concept "pivot irrigation system management" was considered of lesser importance (M = 3.85, SD = 0.95) of the remaining concepts.

Agriscience teachers' confidence levels in teaching water-related concepts are reported in Table 4.17. Confidence levels were similar in range, which showed agriscience teachers had some confidence but weren't fully comfortable with teaching the water-related concept. "State water laws and policies impacting agriculture water management" was the concept agriscience teachers had least confidence in teaching (M = 3.10, SD = 1.09) with "district/regional water laws and policies impacting agriculture water management" (M = 3.12, SD = 1.12) following closely behind. The water-related concept respondents felt they had most confidence in teaching was "accountable/monitoring of household water use" (*M* = 3.48, *SD* = 0.99), although the mean for this objective is only 0.36 higher than the objective of least confidence.

The mean weighted discrepancy score (MWDS) is displayed in Table 4.18, along with the mean and standard deviations for the perceived importance and confidence levels in relation to the water-related topics not included in TEKS. Though there is no standard for interpreting the MWDS, the scores are ranked from the greatest to the least need (McKim & Saucier, 2011).

Table 4.16

Perceived Importance of Water-related Topics Not Included in TEKS (n = 497)

			Very Low Importance		Low Importance		Moderate Importance		High Importance		Very High Importance	
Concept	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Creation and use of drought tolerant/water efficient crop varieties in agriculture production. (*n* = 394)	4.20	0.82	0	0.0	9	2.3	73	18.5	142	36.0	170	43.1
Alternative farming practices that conserve water. (*n* = 394)	4.12	0.82	1	0.3	9	2.3	78	19.8	158	40.1	148	37.6
Rain water capture methods. (*n* = 421)	4.11	0.86	3	0.7	10	2.4	87	20.7	158	37.5	163	38.7
Monitoring water runoff in agriculture areas. (*n* = 421)	4.09	0.87	4	1.0	8	1.9	95	22.6	155	36.8	159	37.8
Groundwater use in agriculture – practices, issues, and/or trends. (*n* = 423)	4.09	0.84	3	0.7	12	2.8	76	18.0	183	43.3	149	35.2
Water demand issues and trends. (*n* = 421)	4.09	0.81	2	0.5	11	2.6	77	18.3	189	44.9	142	33.7
Contamination of water sources (surface or groundwater) from agriculture production practices. (*n* = 393)	4.09	0.81	2	0.5	7	1.8	79	20.1	172	43.8	133	33.8
Controlling brush growth and development as part of a water management/conservation strategy. (*n* = 394)	4.08	0.83	3	0.8	4	1.0	93	23.6	154	39.1	140	35.5
Property ownership laws related to water. (*n* = 395)	4.07	0.86	2	0.5	9	2.3	94	23.8	143	36.2	147	37.2
Wildlife management as related to water management practices. (*n* = 394)	4.06	0.80	1	0.3	5	1.3	93	23.6	165	41.9	130	33.0
The influence public related water policy decisions on agriculture water use. (*n* = 394)	4.05	0.84	1	0.3	9	2.3	95	24.1	153	38.8	136	34.5
Well water usage – practices, issues, and/or trends. (*n* = 422)	4.04	0.87	4	0.9	14	3.3	85	20.1	176	41.7	143	33.9
Accountable/monitoring of household water use. (*n* = 421)	4.03	0.85	5	1.2	5	1.2	102	24.2	170	40.4	139	33.0

Table 4.16 Continued

Perceived Importance of Water-related Topics Not Included in TEKS (n = 497)

			Very Low Importance		Low Importance		Moderate Importance		High Importance		Very High Importance	
Concept	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
State water laws and policies impacting agriculture water management. (*n* = 394)	4.01	0.90	2	0.5	20	5.1	86	21.8	152	38.6	134	34.0
Industrial usage of water – practices, issues, and/or trends. (*n* = 422)	4.01	0.86	4	0.9	13	3.1	91	21.6	182	43.1	132	31.3
Recreational water management practices. (*n* = 393)	4.00	0.84	2	0.5	10	2.5	97	24.7	160	40.7	124	31.6
District/Regional water laws and policies impacting agriculture water management. (*n* = 394)	3.98	0.84	1	0.3	15	3.8	91	23.1	169	42.9	118	29.9
The influence agriculture industry related water policy decisions on water conservation. (*n* = 395)	3.97	0.83	0	0.0	15	3.8	95	24.1	171	43.3	114	28.9
Water recharge trends and research. (*n* = 422)	3.94	0.86	2	0.5	19	4.5	99	23.5	185	43.8	117	27.7
Accountable/monitoring of agriculture water use. (*n* = 424)	3.93	0.90	10	2.4	7	1.7	105	24.8	183	43.2	119	28.1
Drip irrigation system management. (*n* = 394)	3.93	0.90	2	0.5	18	4.6	107	27.2	144	36.5	123	31.2
Soil moisture monitoring – practices and technologies. (*n* = 392)	3.92	0.89	3	0.8	18	4.6	100	25.5	158	40.3	113	28.8
Use of rivers for irrigation purposes. (*n* = 395)	3.91	0.91	4	1.0	18	4.6	104	26.3	153	38.7	116	29.4
Pivot irrigation system management. (*n* = 394)	3.85	0.95	5	1.3	25	6.3	105	26.6	148	37.6	111	28.2
Flood/Furrow irrigation system management. (*n* = 393)	3.83	0.93	3	0.8	27	6.9	110	28.0	145	36.9	108	27.5

Note. Very Low Importance = 1; Low Importance = 2; Moderate Importance = 3; High Importance = 4; Very High Importance = 5.

Table 4.17
Respondents' Confidence Level in Teaching Water-related Topics that are Not Included in TEKS (n = 497)

			Not Confident		Little Confidence		Somewhat Confident		Confident		Very Confident	
Concept	*M*	*SD*	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Accountable/monitoring of household water use. (*n* = 423)	3.48	0.99	13	3.1	48	11.3	151	35.7	143	33.8	68	16.1
Controlling brush growth and development as part of a water management/conservation strategy. (*n* = 385)	3.46	1.06	17	4.4	52	13.5	119	30.9	132	34.3	65	16.9
Water demand issues and trends. (*n* = 422)	3.46	0.95	11	2.6	41	9.7	174	41.2	134	31.8	62	14.7
Recreational water management practices. (*n* = 387)	3.45	1.08	22	5.7	60	15.5	123	31.8	125	32.3	57	14.7
Groundwater use in agriculture – practices, issues, and/or trends. (*n* = 425)	3.43	0.98	15	3.5	50	11.8	156	36.7	146	34.4	58	13.6
Rain water capture methods. (*n* = 410)	3.42	1.10	25	6.1	47	11.5	144	35.1	119	29.0	75	18.3
Well water usage – practices, issues, and/or trends. (*n* = 424)	3.42	1.02	17	4.0	52	12.3	159	37.5	129	30.4	67	15.8
Wildlife management as related to water management practices. (*n* = 387)	3.41	1.02	14	3.6	54	14.0	140	36.2	119	30.7	60	15.5
Contamination of water sources (surface or groundwater) from agriculture production practices. (*n* = 388)	3.40	1.01	16	4.1	49	12.6	137	35.3	134	34.5	52	13.4
Monitoring water runoff in agriculture areas. (*n* = 424)	3.37	1.04	23	5.4	51	12.0	157	37.0	132	31.1	61	14.4
Accountable/monitoring of agriculture water use. (*n* = 424)	3.37	0.96	14	3.3	55	13.0	166	39.2	140	33.0	49	11.6
Alternative farming practices that conserve water. (*n* = 387)	3.34	1.08	22	5.7	59	15.2	128	33.1	120	31.0	58	15.0
Creation and use of drought tolerant/water efficient crop varieties in agriculture production. (*n* = 386)	3.34	1.07	19	4.9	61	15.8	134	34.7	113	29.3	59	15.3
Drip irrigation system management. (*n* = 387)	3.33	1.06	21	5.4	57	14.7	136	35.1	118	30.5	55	14.2
Flood/Furrow irrigation system management. (*n* = 384)	3.30	1.09	24	6.3	63	16.4	122	31.8	124	32.3	51	13.3

Table 4.17 Continued

Respondents' Confidence Level in Teaching Water-related Topics that are Not Included in TEKS (n = 497)

Concept	*M*	*SD*	Not Confident *f*	Not Confident %	Little Confidence *f*	Little Confidence %	Somewhat Confident *f*	Somewhat Confident %	Confident *f*	Confident %	Very Confident *f*	Very Confident %
Water recharge trends and research. (*n* = 424)	3.25	0.99	20	4.7	63	14.9	176	41.5	122	28.8	43	10.1
Pivot irrigation system management. (*n* = 384)	3.24	1.11	29	7.6	64	16.7	124	32.3	118	30.7	49	12.8
Soil moisture monitoring – practices and technologies. (*n* = 387)	3.24	1.09	23	5.9	73	18.9	131	33.9	107	27.6	53	13.7
Industrial usage of water – practices, issues, and/or trends. (*n* = 423)	3.21	1.04	25	5.9	70	16.5	167	39.5	113	26.7	48	11.3
Use of rivers for irrigation purposes. (*n* = 386)	3.20	1.10	29	7.5	68	17.6	135	35.0	105	37.2	49	12.7
The influence agriculture industry related water policy decisions on water conservation. (*n* = 388)	3.17	1.10	29	7.5	71	18.3	140	36.1	101	26.0	47	12.1
Property ownership laws related to water. (*n* = 389)	3.16	1.11	33	8.5	72	18.5	123	31.6	120	30.8	41	10.5
The influence public related water policy decisions on agriculture water use. (*n* = 389)	3.16	1.09	32	8.2	68	17.5	133	34.2	116	29.8	40	10.3
District/Regional water laws and policies impacting agriculture water management. (*n* = 387)	3.12	1.12	33	8.5	74	19.1	138	35.7	96	24.8	46	11.9
State water laws and policies impacting agriculture water management. (*n* = 387)	3.10	1.09	31	8.0	74	19.1	145	37.5	96	24.8	41	8.2

Note. Not Confident = 1; Little Confidence = 2; Somewhat Confident = 3; Confident = 4; Very Confident = 5.

Table 4.18

Respondents' Mean Weighted Discrepancy Score Pertaining to Water-related Topics that are Not Included in TEKS

Concept	MWDS	Importance		Confidence	
		M	*SD*	*M*	*SD*
Property ownership laws related to water. *n* = 385	3.67	4.07	0.86	3.16	1.11
The influence public related water policy decisions on agriculture water use. *n* = 384	3.61	4.05	0.84	3.16	1.09
State water laws and policies impacting agriculture water management. *n* = 383	3.56	4.01	0.90	3.10	1.09
Creation and use of drought tolerant/water efficient crop varieties in agriculture production. *n* = 382	3.55	4.20	0.82	3.34	1.07
District/Regional water laws and policies impacting agriculture water management. *n* = 383	3.38	3.98	0.84	3.12	1.12
Industrial usage of water – practices, issues, and/or trends. *n* = 421	3.25	4.01	0.86	3.21	1.04
The influence agriculture industry related water policy decisions on water conservation. *n* = 384	3.17	3.97	0.83	3.17	1.10
Alternative farming practices that conserve water. *n* = 383	3.16	4.12	0.82	3.34	1.08
Monitoring water runoff in agriculture areas. *n* = 420	2.96	4.09	0.87	3.37	1.04
Rain water capture methods. *n* = 406	2.92	4.11	0.86	3.42	1.10
Contamination of water sources (surface or groundwater) from agriculture production practices. *n* = 382	2.77	4.09	0.81	3.40	1.01
Groundwater use in agriculture – practices, issues, and/or trends. *n* = 422	2.74	4.09	0.84	3.43	0.98
Water recharge trends and research. *n* = 421	2.74	3.94	0.86	3.25	0.99
Use of rivers for irrigation purposes. *n* = 382	2.72	3.91	0.91	3.20	1.10
Soil moisture monitoring – practices and technologies. *n* = 380	2.67	3.92	0.89	3.24	1.09
Recreational water management practices. *n* = 383	2.59	4.00	0.84	3.45	1.08
Wildlife management as related to water management practices. *n* = 383	2.59	4.06	0.80	3.41	1.02
Water demand issues and trends. *n* = 419	2.58	4.09	0.81	3.46	0.95
Well water usage – practices, issues, and/or trends. *n* = 421	2.56	4.04	0.87	3.42	1.02

Table 4.18 Continued

Respondents' Mean Weighted Discrepancy Score Pertaining to Water-related Topics that are Not Included in TEKS

		Importance		Confidence	
Concept	MWDS	*M*	*SD*	*M*	*SD*
Controlling brush growth and development as part of a water management/conservation strategy. *n* = 381	2.45	4.08	0.83	3.46	1.06
Drip irrigation system management. *n* = 382	2.30	3.93	0.90	3.33	1.06
Flood/Furrow irrigation system management. *n* = 392	2.32	3.83	0.93	3.30	1.09
Accountable/monitoring of agriculture water use. *n* = 423	2.29	3.93	0.90	3.37	0.96
Pivot irrigation system management. *n* = 380	2.27	3.85	0.95	3.24	1.11
Accountable/monitoring of household water use. *n* = 419	2.20	4.03	0.85	3.48	0.99

Note. Not Confident = 1; Little Confidence = 2; Somewhat Confident = 3; Confident = 4; Very Confident = 5. Very Low Importance = 1; Low Importance = 2; Moderate Importance = 3; High Importance = 4; Very High Importance = 5.

Findings for Objective Four

Objective four sought to determine the instructional materials and resources used by Texas agriscience teachers in the classroom. Information reported to assist with understanding the support needed was the level of water-related concept inclusion, as well as instructional material respondents prefer for classroom instruction.

The extent respondents include water management concepts, beyond the TEKS, into their classroom was addressed through 25 water-related concepts using a Likert-type scale. Agriscience teachers selected the level of inclusion for teaching the water related topic. The Likert-type scale for inclusion of the water-related topics was as follows: 1 = Hardly Ever, 2 = Occasionally, 3 = Sometimes, 4 = Frequently, 5 = Almost Always.

Table 4.19 displays the level of inclusion agriscience teachers had for each water-related topic. Agriscience teachers felt the concept "wildlife management as related to water management practices" ($M = 3.05$, $SD = 1.10$) was included in the classroom more than the other concepts. Although the means to all objectives were relatively similar in range, the water related concept "accountable/monitoring of agriculture water use" was the concept included the least ($M = 2.65$, $SD = 1.02$) in the classroom.

Table 4.19

Extent Participants' Include Water Management Concepts in Curriculum (n = 497)

Concept	*M*	*SD*	Hardly Ever *f*	Hardly Ever %	Occasionally *f*	Occasionally %	Sometimes *f*	Sometimes %	Frequently *f*	Frequently %	Almost Always *f*	Almost Always %
Wildlife management as related to water management practices. (*n* = 391)	3.05	1.10	37	9.5	80	20.5	135	34.5	105	34.5	34	8.7
Controlling brush growth and development as part of a water management/conservation strategy. (*n* = 390)	3.00	1.12	45	11.5	77	19.7	136	34.9	98	25.1	34	8.7
Alternative farming practices that conserve water. (*n* = 390)	2.97	1.06	43	11.0	75	19.2	142	36.4	109	27.9	21	5.4
Groundwater use in agriculture – practices, issues, and/or trends. (*n* = 421)	2.95	1.02	40	9.5	84	20.0	176	41.8	97	23.0	24	5.7
Creation and use of drought tolerant/water efficient crop varieties in agriculture production. (*n* = 390)	2.93	1.05	44	11.3	79	20.3	150	38.5	96	24.6	21	5.4
Contamination of water sources (surface or groundwater) from agriculture production practices. (*n* = 391)	2.93	1.03	37	9.5	89	22.8	154	39.4	88	22.5	23	5.9
Water demand issues and trends. (*n* = 419)	2.89	1.03	38	9.1	107	25.5	165	39.4	83	19.8	26	6.2
Well water usage – practices, issues, and/or trends. (*n* = 419)	2.87	1.08	53	12.6	93	22.2	154	36.8	95	22.7	24	5.7
Recreational water management practices. (*n* = 389)	2.86	1.12	53	13.6	86	22.1	143	36.8	78	20.1	29	7.5
Drip irrigation system management. (*n* = 389)	2.84	1.10	49	12.6	96	24.7	137	35.2	81	20.8	26	6.7
Monitoring water runoff in agriculture areas. (*n* = 420)	2.84	1.09	55	13.1	92	21.9	168	40.0	74	17.6	31	7.4
Rain water capture methods. (*n* = 420)	2.82	1.17	67	16.0	93	22.1	145	34.5	79	18.8	36	8.6
Soil moisture monitoring – practices and technologies. (*n* = 389)	2.81	1.06	53	13.6	84	21.6	151	38.8	84	21.6	17	4.4
Property ownership laws related to water. (*n* = 392)	2.79	1.12	61	15.6	89	22.7	138	35.2	81	20.7	23	5.9
Flood/Furrow irrigation system management. (*n* = 386)	2.78	1.09	56	14.5	93	24.1	135	35.0	84	21.8	18	4.7

Table 4.19 Continued

Extent Participants' Include Water Management Concepts in Curriculum (n = 497)

Concept	*M*	*SD*	Hardly Ever *f*	Hardly Ever %	Occasionally *f*	Occasionally %	Sometimes *f*	Sometimes %	Frequently *f*	Frequently %	Almost Always *f*	Almost Always %
State water laws and policies impacting agriculture water management. (*n* = 391)	2.78	1.09	59	15.1	88	22.5	145	37.1	78	19.9	21	5.4
The influence public related water policy decisions on agriculture water use. (*n* = 390)	2.77	1.08	62	15.9	81	20.8	151	38.7	78	20.0	18	4.6
District/Regional water laws and policies impacting agriculture water management. (*n* = 391)	2.74	1.11	65	16.6	88	22.5	142	36.3	76	19.4	20	5.1
Pivot irrigation system management. (*n* = 388)	2.74	1.09	59	15.2	92	23.7	149	38.4	66	17.0	22	5.7
Use of rivers for irrigation purposes. (*n* = 388)	2.74	1.09	61	15.7	88	22.7	147	37.9	73	18.8	19	4.9
Accountable/monitoring of household water use. (*n* = 416)	2.74	1.08	56	13.5	117	28.1	151	36.3	64	15.4	28	6.7
The influence agriculture industry related water policy decisions on water conservation. (*n* = 392)	2.74	1.07	61	12.3	90	18.1	148	29.8	76	15.3	17	3.4
Water recharge trends and research. (*n* = 420)	2.70	1.02	55	13.1	115	27.4	168	40.0	64	15.2	18	4.3
Industrial usage of water – practices, issues, and/or trends. (*n* = 420)	2.68	1.06	67	16.0	105	25.0	165	39.3	63	15.0	20	4.8
Accountable/monitoring of agriculture water use. (*n* = 422)	2.65	1.02	60	14.2	118	28.0	172	40.8	53	12.6	19	4.5

Note. Hardly Ever = 1; Occasionally = 2; Sometimes = 3; Frequently = 4; Almost Always = 5.

Agriscience teachers ranked materials used in the classroom on a scale from one to eleven, 1 being the most used, and 11 the least. This ranking determined the preferred method of classroom instruction. The mean ranged from 4.04 to 8.53, with PowerPoint slides being the most used material (*SD* = 2.68), and newsletters/emails being the least used (*SD* = 2.49). Table 4.20 represents the materials the respondents used most in the classroom.

Table 4.20

Materials Used in the Agriscience Classroom (n = 358)

Materials	*Mean*	*SD*
PowerPoint slides	4.04	2.68
Lesson Plans	4.31	3.00
Activities (group/individual)	4.79	3.24
Videos – DVD	5.12	2.89
Student handouts	5.16	2.70
Teacher guide	5.55	2.79
Videos – downloadable	6.56	2.84
Web sites with related content	6.76	3.21
Assessments	6.86	2.79
Digital photos	7.13	2.80
Newsletters/Emails	8.53	2.49

Note. Materials were ranked on a scale of 1 – 11: Most Used – Least Used Resource.

Informational resources were methods agriscience teachers used to supplement their instructional materials. To determine the preference respondents had on using informational resources in the classroom, a scale from one to eleven, 1 being the most used and 11 the least, was used to rank the resources. The mean ranged from 2.15 to 8.87, with the Internet being the most used resource (*M* = 2.15, *SD* = 1.81) and social media technology being the least used (*M* = 8.87, *SD* = 2.76). Table 4.21 represents the materials the respondents used most in the classroom.

Table 4.21

Informational Resource Most Used in the Classroom (n = 379)

News and Information Sources	*Mean*	*SD*
Internet	2.15	1.81
Agriculture-focused magazines and journals	3.78	2.53
Education/teaching-focused magazines and journals	4.88	2.95
Personal Sources	5.28	2.55
Newsletters from agriculture-related organizations (*n* = 407)	5.57	2.33
Local TV Channels	6.03	2.90
Newspaper (print or electronic)	6.15	4.00
Satellite/cable TV channel	6.69	2.66
Radio	7.49	2.61
Non-agriculture magazines and	8.67	2.01
Social media technology	8.87	2.76

Note. Resources were ranked on a scale of 1 to 11: Most Used – Least Used Resource.

Chapter V

Summary, Conclusions, and Recommendations

Overview

Chapter V will provide conclusions from the data collected for each objective in this study and provide recommendations for practitioners and for future research.

Purpose and Objectives

The purpose of this study was to determine the instructional needs of Texas agriscience teachers as it pertains to the teaching of agricultural water management and conservation. The specific objectives that guided this study were:

1. Describe Texas agriscience teachers through demographic variables: age, gender, ethnicity, highest degree received, completed years teaching, students enrolled in the agriscience program, background in agriculture, and water management related experience.
2. Determine the extent water management and conservation is being taught in terms of content, instructional materials used, and classroom/laboratory activities.
3. Determine current Texas agriscience teachers' self-efficacy levels with teaching water management and conservation and their interest levels/motivation (personal and community) in expanding water management and conservation instruction in their school.
4. Determine the instructional materials and resources used by Texas agriscience teachers in the classroom.

Procedure

The target population of this study was Texas agriscience teachers located in Texas FFA Areas I, II, IV, VII, and X. A membership list of teachers for each area was obtained through the Vocational Agriculture Teachers Association of Texas. Questionnaires were distributed at the annual VATAT conference in July 2011 and only completed questionnaires were turned in. In late August, an additional questionnaire was distributed via SurveyMonkey to agriscience teachers who did not participate at the VATAT conference. This data collection process yielded 497 responding agriscience teachers. The responses were coded and entered into SPSS® version 18 for statistical analysis.

Conclusions Related to Objective One

The purpose of objective one was to describe Texas agriscience teachers through demographic variables of age, gender, ethnicity, highest degree received, completed years teaching, students enrolled in the agriscience program, background in agriculture, and water management related experience.

The mean years of teaching agricultural education for the respondents was 11.9 years (SD = 9.8) with a minimum of one year and a maximum of 45 years. In comparison, the 2010 study conducted by Jones yielded similar results when she reported the average years teaching of agriscience teachers to be 11.1 years.

The observable age range was 47 years with a minimum of 21 and maximum of 68. The mean was 37.7 (SD = 11.1). In comparison, Jones (2010) reported the average age of agriscience teachers to be 40.4 years. The approximate three-year difference in the averages is a relatively minor difference that could be attributed to new teachers coming into the profession and previous teachers retiring.

A greater amount of males (*n* = 308, 89.1%) responded to the questionnaire as compared to female respondents (*n* = 68, 18.1%). This data is slightly different from the 2010 VATAT census information that shows 76% of agriscience teachers as male with 24% of the agriscience teachers as female (K. Grumbles, personal communication, July 19, 2011). A majority of respondents were white (*n* = 329, 87.7%) while the fewest amount of respondents were either African American (*n* = 1, 0.3%) and “Other” (*n* = 1, 0.3%). The other ethnicity represented was Hispanic (*n* = 44, 11.7%). Studies conducted by Jones (2010) and Miller (2006) also reported the majority of agriscience teachers surveyed were white. Therefore this study’s ethnicity demographic data is representative of the population.

Agriscience teachers’ highest levels of education ranged from a bachelors degree (*n* = 195, 51.8%) to a doctoral degree (*n* = 2, 0.5%). A portion of respondents indicated that they have taken some master’s level courses (*n* = 62, 16.5%) and 29.3% (*n* = 110) have completed a master’s degree.

Most agriscience teachers (60.0%) indicated ranching was their paid agriculture-related work experience prior to teaching, while 55.5% listed also having a farming background. For related work experience prior to teaching, Jones’ (2010) study reported 40.7% and 25.9% for ranching and farming respectively. These differences could be a result of a larger population, along with agriscience teachers’ participation representing more Texas FFA areas in this study.

Livestock production experiences (*n* = 333, 82.4%) ranked first as water management experience, paid or unpaid, teachers had prior to becoming an agriscience teacher. Whereas youth organizational experience (*n* = 291, 72.0%) ranked second.. As reported in the 2010 Jones study, agriscience teachers also ranked their prior water management experience to be livestock production as first, and youth organizations as second. Jones (2010) also determined that the population had used the prior experience as a tool to help in the profession they are in today. Livestock production and youth organizational experience go hand-in-hand since livestock production is seen heavily in youth organizations, such as 4-H and FFA.

One hundred eighty-six (*n* = 186, 37.4%) agriscience teachers indicated they search for water management and conservation information at least once a month. Of those 186 agriscience teachers, 12% (*n* = 60) seek out information on water management and conservation at least weekly. Since a number of respondents are frequently searching for information on water management and conservation, it can conclude that teachers understand the importance and relevance of this topic.

Conclusions Related to Objective Two

The purpose of objective two was to determine the extent water management and conservation is being taught in terms of content, instructional materials used, and classroom/laboratory activities. Twenty-five water-related concepts, beyond the TEKS statement, were developed and combined using a five-point Likert-type scale (hardly ever to almost always).

Respondents were asked how often they included each concept into their curriculum taught. The findings indicated respondents selected "wildlife management as related to water management practices" (*M* = 3.1) as the most frequent concept relating to water management and conservation with "accountable/monitoring of agriculture water use" (*M* = 2.7) being the least included curriculum concept taught. The range for "sometimes" including a concept into curriculum taught was 2.51 to 3.5. The higher level of inclusion for material related to wildlife management can be determined through the mandated curriculum (TEKS) for the class Wildlife and Recreation Management.

Concepts pertaining to water policy least included in the classroom were "district/regional water laws and policies impacting agriculture water management" (*M* = 2.7) and "the influence agriculture industry related water policy decisions on water conservation" (*M* = 2.7). Though the two previous concepts were taught little in the classroom, the water policy concept used most in the classroom, "property ownership laws related to water" (*M* = 2.8), had a mean that was only 0.04 higher than the water policy concepts least used. Again, the findings show there is not a large scale difference in the level of inclusion, but agriscience teachers are only "sometimes" teaching the concept. Therefore agriscience teachers are teaching little in relation to water policy in the classroom.

Because instructional materials are a crucial part of the agriscience teachers' classroom, multiple forms of media were being used by the respondents. The findings showed physically formatted videos were the most used resource (87.8%) followed by curriculum kits (86.3%). Teachers also sought out web sites for print content and/or lessons (74.6%, *n* = 306). Since a number of teachers are using instructional material that is easy to use and readily available, it can conclude that teachers want lessons/instructional material that require minimal preparation time.

Agriscience teachers typically obtain the news and information they would use in their agriscience program through the Internet (91.7%). Although 374 respondents prefer the Internet as a method for obtaining information, only 82 (20.1%) of respondents used social media technology as a resource. It can be concluded that agriscience teachers obtain news and information through sources as quickly as possible, with minimal effort needed.

Conclusions Related to Objective Three

The purpose of objective three sought to determine Texas agriscience teachers' self-efficacy levels with teaching water management and conservation and their interest levels/motivation (personal and community) in expanding water management and conservation instruction in their school.

Respondents' beliefs and attitudes on water management and conservation were examined on a six-point Likert-type scale (1 = strongly disagree, 6 = strongly agree). The majority of responding agriscience teachers agreed it is important for the community/state to have reliable and effective water management operations (M = 5.5, SD = 0.9) and that there is too much water usage with agriculture (M = 5.4, SD = 0.8). Respondents' felt their quality of life would remain the same even if there was a water shortage in their area (M = 2.3, SD = 1.3) and they believed Texas is at risk of significant water shortages in the next 5 – 10 years (M = 2.5, SD = 1.3). Agriscience teachers have strong beliefs on water management and conservation, but do not believe there are risks of water shortages in their local area and Texas.

Other factors that may influence participants' teaching of water management and conservation in the Texas agriscience classroom were examined. The majority of respondents felt the majority of the agriscience teachers with whom they are acquainted with would think that water management and conservation is important (*M* = 5.1, *SD* = 0.7) and that they should include water management and conservation in their curriculum (*M* = 4.7, *SD* = 0.8). Respondents also felt most people important in their life would think water management and conservation are important (*M* = 5.1, *SD* = 0.8) and that they should include it in their curriculum (*M* = 4.8, *SD* = 0.8). The majority of agriscience teachers believed their administration is supportive of their program (*M* = 4.9, *SD* = 1.1) and that they have full control of what they teach (*M* = 5.0, *SD* = 0.8) and could include water management and conservation (*M* = 5.1, *SD* = 0.6) in the classroom.

With the implementation of the TEKS in the classroom, questions asking the importance and confidence levels agriscience teachers felt on water-related TEKS statements were asked. The level of importance was based on a five-point Likert-type scale (1 = Very Low Importance, 5 = Very High Importance). With a range of 3.91 – 4.24 respondents' viewed all statements as of "high importance." Agriscience teachers felt teaching the TEKS "explain the importance of soil and water conservation for future generations" (*M* = 4.2, *SD* = 0.8) was of greater importance. Following closely behind were the TEKS "identify water conservation methods" (*M* = 4.1, *SD* = 0.8) and "demonstrate the impacts of agriculture upon land, air, and water resources" (*M* = 4.1, *SD* = 0.8). Though the means to all statements were relatively similar in range, "discuss the environmental history, laws, legislation, and regulations" was considered of lesser importance (*M* = 3.9, *SD* = 0.9) of the remaining TEKS. With new regulations on water usage, discussing environmental history, laws, and legislation, the implementation of the last statement would be extremely beneficial to the students and would reinforce all TEKS being taught.

The findings showed confidence levels were extremely close in showing agriscience teachers were uncomfortable with teaching. The respondents' level of confidence was based on a five-point Likert-type scale (1 = Not Confident, 5 = Very Confident). Responses ranged from "somewhat confident" (2.51 – 3.50) to "confident" (3.51 – 4.50). Although probably the most crucial TEKS "discuss the environmental history, laws, legislation, and regulations," agriscience teachers felt least confident (*M* = 3.4, *SD* = 1.1) in teaching the objective. "Analyze conservation and environmental policies related to local, state, and national levels" (*M* = 3.4, *SD* = 1.0) and "list factors involved in landowner and property rights" (*M* = 3.5, *SD* = 1.1) were the two other TEKS under the participants' responses for "somewhat confident." The TEKS that agriscience teachers felt they had most confidence in was "explain the importance of soil and water conservation for future generations" (*M* = 3.8, *SD* = 0.9) although the mean for this objective is only 0.43 higher than the objective of least confidence. It can be concluded that agriscience teachers lack confidence in teaching TEKS related to water policy. A better understanding of the materials would allow for teachers to develop a stronger confidence level in each particular TEKS.

Agriscience teachers felt, with a mean of 4.2, the concept "creation and use of drought tolerant/water efficient crop varieties in agriculture" was of greater importance to include in classroom instruction. Although the means to all objectives were relatively similar in range, the water-related concept "pivot irrigation system management" was considered of lesser importance (*M* = 3.9, *SD* = 1.0) of the remaining concepts.

Confidence levels for agriscience teachers were extremely close in range, which showed participants had some confidence, but weren't fully comfortable with teaching the water-related concept. With a mean of 3.1, the concept agriscience teachers show least confidence in teaching was "state water laws and policies impacting agriculture water management" with "district/regional water laws and policies impacting agriculture water management" ($M = 3.1$) following closely behind. Agriscience teachers felt they were more confident ($M = 3.5$) in teaching "accountable/monitoring of household water use", although the mean for this objective is only 0.36 higher than the objective of least confidence. Even though the concepts were all relatively similar in range, teachers only felt "somewhat" confident in their ability to teach them.

Overall, researchers feel it would be beneficial for teachers to broaden their understanding and knowledge levels on water management and conservation. This would help increase importance and confidence levels in teaching the water-related TEKS.

Conclusions Related to Objective Four

The purpose of objective four sought to determine the instructional materials and resources Texas agriscience teachers used in the classroom. Information reported to assist with understanding the support needed was the level of water-related concept inclusion, as well as instructional material respondents prefer for classroom instruction.

Agriscience teachers indicated their preference for classroom instruction was using PowerPoint slides. With the ability to show graphics, as well as use written word to reinforce their point, made for easy to understand lessons. Informational resources were methods agriscience teachers used to supplement their instructional materials. The Internet was the most used informational resource followed by agriculture-focused magazines. These resources give specific information pertaining to the individual topic being taught.

Recommendations

Recommendations developed from this study are divided into two sections: Recommendations to practitioners and recommendations for future research that should be completed.

Practitioners

Most participants agreed water management and conservation could be taught in their classroom curriculum. A recommendation for practitioners would be to provide a curriculum kit (lesson plan, instructional material, and instructional ideas) for each content area of being taught in the classroom, as well as the possibility of the lesson relating to each area of Texas being represented.

When distributing new instructional materials and/or curriculum, it is important for the teacher to feel confident and knowledgeable over the topics. These new materials and/or curriculum should be supplemented with in-service training efforts. This can be done at future VATAT conferences or via the internet by recording.

Instructional materials should be supplemented by water-related organizations at least monthly. This will allow for teachers to stay better informed on the issues pertaining to water management and conservation.

Researchers

It is recommended to replicate this study in the five areas not included in this study. Also, it is recommended that this study be replicated using the five areas included in this study to examine potential changes over time, as well as in non-drought years.

Participants appreciated the interest in understanding their instructional needs, but would have preferred a shorter questionnaire. One recommendation for practitioners would be to create a questionnaire that is shorter and focuses mainly on instructional materials and methods of teaching.

This study examined the agriscience teacher's perception of importance, confidence, and inclusion levels of water management and conservation. Additional research should be conducted on why teachers feel a concept is important, what makes them confident/not confident in teaching the concepts, and why they include/not include the concept in their classroom instruction.

It is recommended for researchers to look at the possible response bias sections and conduct research on reasons respondents showcase this bias. Look at multiple methods to help reduce bias in future studies. These bias areas were located in the areas relating to the respondents levels of confidence, importance, and inclusion.

If instructional material and/or curriculum on water management and conservation are provided for teachers, it would beneficial to conduct a study that spans over a full school year. Conduct questionnaires quarterly, at the end of each 9 weeks, to gain insight on the teachers' level of inclusion with water management and conservation, as well as what would better benefit them on including it more.

Discussion

Several similarities to Hall and Hord's (1987) concerns-based adoption model are seen through the responses of the agriscience teachers (Figure 5.1).

Figure 5.1 Concerns-Based Adoption Model: Stages of Concern (Hall & Hord, 1987).

Awareness

There is a definite awareness of the need to teach water management and conservation due to record breaking drought conditions in 2011, especially during the summer when data was collected. Respondents are aware of the diminishing amounts of water resources in their area and throughout the state.

Informational

In the next stage of concern, informational, agriscience teachers should seek multiple forms of media as a method of increasing their knowledge on water management and conservation. Teachers responded that their main source of information was through the Internet followed by agriculture-focused magazines and journals. A small percentage of agriscience teachers never sought out information on water management and conservation while less than half of the responding teachers frequently, at least monthly, seek out information. In order to move to the next stage of concern, agriscience teachers need to have a better understanding of the topic.

Personal

The beliefs and attitudes agriscience teachers have on water management and conservation influences their level of concern. The teachers' view of how important the topic is, along with their confidence in teaching the subject can vary based on their comfort level. These personal factors have an effect on the management stage in terms of what can and will be taught in the classroom.

Management

The inclusion of water management and conservation materials into the curriculum is not only affected by the personal views of the agriscience teacher, but by the method of instruction the teacher feels comfortable presenting to the class. Based on responses, teachers' felt that a PowerPoint presentation would be the most beneficial, incorporating the word slides with picture and diagram slides, would help facilitate the students' understanding of the subject.

Response Bias

Researchers believe extreme and moderate responding bias, or extreme response style, played a role in this study. Furr and Bacharach (2008) state extreme and moderate responding "refers to differences in the tendency to use or avoid extreme responding options" (p. 244). Respondents may differ in their willingness to select set options based on their level of knowledge or insecurity of social norms. In this case, respondents will take the middle of the road, or moderate responses. This can obscure differences in true construct levels, which in this study were based on a Likert-type scale. In this study, it was noted in numerous areas, the respondents selected answer choices in the moderate range of construct levels.

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Appendix A

Instrument

INSTRUCTIONAL NEEDS OF TEXAS AGRICULTURE TEACHERS IN TEACHING AGRICULTURE WATER MANAGEMENT AND CONSERVATION

Texas Tech University

Department of Agricultural Education and Communications

The purpose of the *Texas Alliance for Water Conservation* (TAWC) project is to promote water conservation efforts while maximizing profitability in farming operations. This purpose will be partially achieved through educational efforts that help share the latest research and best practices. This will help facilitate the decision-making processes by those associated with the agriculture industry — from producers to policy makers.

High school agriscience teachers are an important factor in the future success of Texas' agriculture industry. As one of the early influencers of future industry leaders, teachers help to shape individual students and the communities in which they teach and reside.

To assist teachers such as yourself, we are conducting this study to understand what instructional support you may need to help meet any water management instructional goals you may have. In addition, we want to better understand your water quantity knowledge, the confidence level you have in teaching water-related issues, and your personal attitudes towards water management issues. Your responses will help to shape the assistance and materials that can be created and provided to you.

Because some teachers may have moved from outside the area or are just starting as agriscience teachers, this study is limited to those who taught in agriscience programs in this area.

It should take you 10-12 minutes to complete this questionnaire. Please respond based on your experiences for the 2010-11 school year. Please be aware that your identity will be kept confidential and anonymous and all forms will be destroyed once the research has been completed. As such, no one will know your individual responses to this questionnaire.

It is very important that you answer as truthfully and completely as possible. To show our appreciation for your cooperation, all who complete the questionnaire may also submit their name for a $50 gift certificate drawing.

Participation in this study is completely voluntary. We hope that you will help with this study so that we may in turn help you and other teachers across the state.

Thank you for your assistance.

Nichole Sullivan
Master's Graduate Student

Dr. David Doerfert
Associate Chair and Professor

Section A:

Personal Beliefs and Attitudes about Water Management and Conservation

INSTRUCTIONS: For each of the following statements please place an X or √ in the correct box that describes your level of agreement with each statement.	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1. It is important for the community/state to have reliable and effective water management operations.						
2. The challenges with water management are the same as they were five years ago.						
3. Water management will become more costly over the next five years.						
4. It is important to have a written set of principles and guidelines related to water management.						
5. If there was a water shortage in my area, my quality of life would remain stable.						
6. Texas is at risk of significant water shortages in the next 5 – 10 years.						
7. Texas is at risk of significant water shortages in the next 25 – 50 years.						
8. There is too much water usage with agriculture.						
9. Farmers do too little to conserve water.						
10. Besides human consumption, the most important use of our water resources is for agriculture production and processing.						
11. Production agriculture could improve its water management practices to conserve more water.						
12. Water management by farmers and ranchers needs to be regulated if water use is to be reduced						
13. New water management technologies is our best hope to reduce water use on farms and ranches.						
14. The community I live in uses too much water.						
15. Groundwater research is important to future generations.						
16. Water related education is of little importance for the general public.						
17. It is important to teach our youth on water management and conservation.						
18. I believe that agriscience teachers should be teaching about water management and conservation						
19. I should be including more water management and conservation content in my curriculum.						

Section B:

Other Factors That May Influence the Teaching of Water Management and Conservation in the Texas Agriscience Classroom

INSTRUCTIONS: For each of the following statements please place an X or √ in the correct box that describes your level of agreement with each statement.	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
What Others Think						
1. Most people important in my life would think that water management and conservation are important.						
2. Other agriscience teachers with who I am acquainted would think that water management and conservation are important						
3. Most people important in my life would think that I should include water management and conservation in my curriculum.						
4. Other agriscience teachers with who I am acquainted would think that I should include water management and conservation in my curriculum.						
Ability to Make Desired Curriculum Changes						
5. I believe I could include water management and conservation in my curriculum.						
6. Teaching water management and conservation would be compatible in all my classes.						
7. I feel my students could use a better understanding of water management and conservation.						
8. My principal is supportive of my program.						
9. My superintenndent is supportive of my program.						
10. Within my program, I could include water management and conservation if I wanted to.						
11. I have complete control over what I teach, thus I could include water management and conservation.						
12. My administration does not require me to teach on water management and conservation.						
13. My administration expects me to teach on water management and conservation.						

Section C:

Water-related Texas Essential Knowledge and Skills (TEKS) for Agriculture Science and Technology Programs

INSTRUCTIONS: Below is a listing of the water-related Texas Essential Knowledge and Skills for agriscience programs. Please use the following response key to respond to each of the water-related TEKS statements below.

Response Key

How important you think water-related TEKS is:
1 = Very Low Importance
2 = Low Importance
3 = Moderate Importance
4 = High Importance
5 = Very High Importance

Your confidence in teaching the water-related TEKS
1 = Not confident
2 = Little confidence
3 = Somewhat confident
4 = Confident
5 = Very Confident

For each column please circle the response that best fits you.

How important you think water-related TEKS is:	**Objective**	**Your confidence in teaching the water-related TEKS:**
119.12 Introduction to World Agricultural Science and Technology		
1 2 3 4 5	Demonstrate the impacts of agriculture upon land, air, and water resources.	1 2 3 4 5
119.13 Applied Agricultural Science and Technology		
1 2 3 4 5	Identify water conservation methods.	1 2 3 4 5
119.22 Energy and Environmental Technology		
1 2 3 4 5	Determine the importance and scope of natural resources, energy, and environment.	1 2 3 4 5
1 2 3 4 5	Analyze conservation and environmental policies related to local, state, and national levels.	1 2 3 4 5
1 2 3 4 5	Identify water and wastewater use and management.	1 2 3 4 5
119.23 Exploring Aquaculture		
1 2 3 4 5	Describe water resource management.	1 2 3 4 5

How important you think water-related TEKS is:	Objective	Your confidence in teaching the water-related TEKS:
119.28 Plant and Animal Production		
1 2 3 4 5	Explain the importance of soil and water conservation for future generations	1 2 3 4 5
119.46 Wildlife and Recreation Management		
1 2 3 4 5	Identify laws and regulations regarding the utilization of wildlife resources.	1 2 3 4 5
1 2 3 4 5	List factors involved in landowner and property rights.	1 2 3 4 5
119.47 Range Management and Ecology		
1 2 3 4 5	Describe the impact of rangeland on the water cycle and water quality.	1 2 3 4 5
119.49 Environmental Technology		
1 2 3 4 5	Explain the relationships between people, environment, and natural resources.	1 2 3 4 5
1 2 3 4 5	Explain the use and abuse of natural resources.	1 2 3 4 5
1 2 3 4 5	Discuss the environmental history, laws, legislation, and regulations	1 2 3 4 5
119.83 Agriculture Resources		
1 2 3 4 5	Manage natural resources in relation to land, water, and air management.	1 2 3 4 5
1 2 3 4 5	Develop management skills for natural resources.	1 2 3 4 5

Section D:

Importance of Curriculum, Current Inclusion of Curriculum, and Confidence in Teaching Water-related Texas Essential Knowledge and Skills (TEKS)

INSTRUCTIONS: Beyond the water-related Texas Essential Knowledge and Skills for agriscience programs, agricultural education-related programs have also taught the following water-related topics. Please use the following response key to respond to each of the topics listed below.

Response Key		
How important you think the water-related topic is:	**Extent the topic is currently included in your curriculum**	**Your confidence in teaching the water-related topic**
1 = Very Low Importance	1 = Hardly Ever	1 = Not confident
2 = Low Importance	2 = Occasionally	2 = Little confidence
3 = Moderate Importance	3 = Sometimes	3 = Somewhat confident
4 = High Importance	4 = Frequently	4 = Confident
5 = Very High Importance	5 = Almost Always	5 = Very Confident

For each column please circle the response that best fits you.

How important you think the water-related topic is:	Concept	Extent the topic is currently included in curriculum:	Your confidence in teaching the water-related topic:
1 2 3 4 5	Accountable/monitoring of agriculture water use	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Accountable/monitoring of household water use	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Water demand issues and trends	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Water recharge trends and research	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Groundwater use in agriculture – practices, issues and/or trends	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Industrial usage of water – practices, issues and/or trends	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Well water usage – practices, issues and/or trends	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Rain water capture methods	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Monitoring water runoff in agriculture areas	1 2 3 4 5	1 2 3 4 5

How important you think the water-related topic is:	Concept	Extent the topic is currently included in curriculum:	Your confidence in teaching the water-related topic:
1 2 3 4 5	Contamination of water sources (surface or groundwater) from agriculture production practices	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Pivot irrigation system management	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Drip irrigation system management	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Flood/Furrow irrigation system management	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Soil moisture monitoring – practices and technologies	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Use of rivers for irrigation purposes	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Creation and use of drought tolerant/water efficient crop varieties in agriculture production	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Alternative farming practices that conserve water	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Recreational water management practices	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Controlling brush growth and development as part of a water management/conservation strategy	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Wildlife management as related to water management practices	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	State water laws and policies impacting agriculture water management	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	District/Regional water laws and policies impacting agriculture water management	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	The influence agriculture industry related water policy decisions on water conservation	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	Property ownership laws related to water	1 2 3 4 5	1 2 3 4 5
1 2 3 4 5	The influence public related water policy decisions on agriculture water use	1 2 3 4 5	1 2 3 4 5

Section E:

Use of Instructional Materials and Related Information Sources

INSTRUCTIONS: The following section will help us make decisions on how to prepare instructional materials that may benefit teachers and their agriscience programs. Please answer each question as completely as possible.

1. Please indicate the types of media you currently use in classroom instruction: ***(please check all that apply)***
   - _ Curriculum kits (e.g. a self-contained package with a teacher guide, students handouts, assessments, PowerPoint slides, lessons)
   - _ Magazines
   - _ Newspapers
   - _ Textbooks – print format
   - _ Textbooks – digital format
   - _ Videos in a physical form (VHS/DVDs)
   - _ Websites/Internet for print content and/or lessons
   - _ Websites/Internet for video/image content (e.g. YouTube video)
   - _ Other:___________________________

2. How do you typically obtain the news and information that you would use in your agriscience program? ***(Please select all that apply)***
   - _ Agriculture-focused magazines and journals
   - _ Education/teaching-focused magazines and journals
   - _ Internet
   - _ Local TV channels
   - _ Newsletters from agriculture-related organizations
   - _ Newspaper (print or electronic)
   - _ Non-agriculture magazines and journals
   - _ Personal sources (discussions with a colleague, friend, etc.)
   - _ Radio (local or satellite)
   - _ Satellite/cable TV channel that did not originate from a local/regional city
   - _ Social media technology (Twitter, Facebook, RSS feeds, etc.)
   - _ Other source ___________________________

3. Please **rank** the order each of the sources below to indicate your preferences in where you typically obtain the news and information that you use in your agriscience program *("1" = the most used resource; "11" = the least used resource)*:
   ____ Agriculture-focused magazines
   ____ Education/teaching-focused magazines and journals
   ____ Internet
   ____ Local TV channels
   ____ Newsletters from agriculture-related organizations
   ____ Newspaper (print or electronic)
   ____ Non-agriculture magazines
   ____ Personal sources (discussions with a colleague, friend, etc.)
   ____ Radio
   ____ Satellite/cable TV channel that did not originate from a local/regional city
   ____ Social media technology (Twitter, Facebook, RSS feeds, etc.)

4. If you were to add more water management content to your curriculum, what would your desired format for instructional materials? Please **rank** the following instructional material formats you find as beneficial to teaching in the classroom *("1" = the most used resource; "11" = the least used resource)*:
   ____ Activities (group and/or individual)
   ____ Assessments (exams, quizzes)
   ____ Digital photos
   ____ Lesson plans
   ____ Newsletters/emails sent to me with latest information/research
   ____ PowerPoints slides
   ____ Student handouts
   ____ Teacher guide
   ____ Videos – DVD format
   ____ Videos – downloadable digital file format
   ____ Web sites with related content
   ____ Other ________________________

5. During the school year, approximately how much time do you spend preparing/creating instructional material/lessons each day?
   Less than 1 hour/day
   1 – 1.5 hours
   1.5 – 2 hours
   More than 2 hours/day

Section F:

Your Experience with Water Management & Conservation

1. In the past 3 months, how much have you read, heard, or seen about the water supply in your area?
   - None
   - A little
   - Some
   - A great deal

2. Please indicate all agriculture-related <u>paid</u> work related experience prior to teaching: (check all that apply or NONE)
   - Farmer
   - Rancher
   - Extension
   - Industry (related to agriculture production or processing)
   - Other: (please specify) ______________________________
   - NONE

3. Please indicate your water management related agriculture experiences (paid and unpaid) prior to becoming an agriscience teacher: (please check all that apply)
   - Crop production experience (agronomic crops)
   - Crop production experience (horticulture, nursery, or forestry crops)
   - Experience with agriculture irrigation systems
   - Experience with home/lawn irrigation systems
   - Livestock production (farming or ranching)
   - Youth organization experience (e.g. 4-H, FFA, etc)
   - Other: ______________________________________

4. How frequently would you estimate that you look for/seek out information related to water management & conservation? (please check only one)
   - Never
   - Yearly
   - More than once a year but less than monthly
   - Monthly
   - More than once a month but less than weekly
   - Weekly
   - More than once a week but less than daily
   - Daily
   - More than once a day

Section G:

Demographics

1. What is the zip code of your school for the 2010-11 school year? ___________

2. Did you move schools? Yes / No
   If so, what is the new zip code or name of the school? _________

3. How many years have you been in the agriculture education profession? ___________ Years

4. How many agriscience teachers were employed by your school district? ___________ Teachers

5. What was the total number of students enrolled in your agriscience program for the 2010-11 school year? ___________ Students

6. What is your age as of July 1, 2011? _______ Years

7. Please indicate your gender:
   - Male
   - Female

8. What is the highest level of education you have completed?
   - Bachelor's degree
   - Completed some master's-level courses
   - Master's degree
   - Completed some doctoral-level courses
   - Doctoral degree

9. Please indicate your ethnicity.
   - White/Caucasian
   - Hispanic/Latino
   - Black/African American
   - Asian/Pacific Islander
   - American Indian
   - Other (please specify)

Are there any other comments related to water management instruction in agriscience programs that you would like to share?

Thank you for your help with this study!

Appendix B

Administrator's Script

Administrator's Script

Hello, I am with the Department of Agricultural Education and Communication at Texas Tech University. We are conducting a brief survey related to agriscience instruction and the incorporation of agriculture water management and conservation content into the local curriculum. We are asking participants at this area meeting if they would be willing to complete a questionnaire.

The individual conducting this study is Ms. Nichole Sullivan who completing this study for her thesis under the supervision of Dr. David Doerfert, Associate Chair and Professor of Agricultural Communications at Texas Tech University.

The purpose of this study is to determine the instructional needs of Texas agriculture science teachers as it pertains to the teaching of agricultural water management and conservation. The results of this study will be use to create instructional support and professional development opportunities for Texas agriscience teachers.

Participation in this study is completely voluntary and you may withdraw from it at any time. All responses will remain confidential, as only summarized data will be reported in order to protect the identity of respondents. Your name will in no way be associated with your responses or the results of the study. There is no risk to your physical, psychological or economic well-being foreseen.

As an incentive to participate in this study, attached to the front of your questionnaire is a sheet of paper to collect your name and contact information (school name, phone number and email address). This sheet of paper will be used to conduct a drawing for a $50 gift card. Only those who completes the questionnaire will be eligible for the drawing. When you return completed questionnaire to the researcher, you will be asked to remove that paper and deposit it in a separate collection box. This process will prevent the researcher from associating your identity to your responses on the questionnaire. From these contact information sheets, the researchers will draw a single name with that person receiving a $50 gift card. The name drawn by the researcher will be notified by August 5, 2011 with the gift card being sent as soon as possible.

For questions about your rights as a subject, contact the Texas Tech University Institutional Review Board for the Protection of Human Subjects, Office of Research Services, Texas Tech University, Lubbock, Texas 79109, or by phone at (806) 712-3881.

If you have questions about this study you can contact Dr. David Doerfert at david.doerfert@ttu.edu or call (806) 742-2816. Thank you again for participating in this study.

Appendix C

Informational Sheet for Incentive

Instructional Needs of Texas Agriculture Teachers in Teaching Agriculture Water Management and Conservation

(Incentive Drawing)

Name:______________________________

School Name:______________________________

Phone Number:______________________________

Email:______________________________