TECHNICAL SUBJECT MATTER COMPETENCY OF TEXAS AGRICULTURE AND NATURAL RESOURCE EXTENSION AGENTS AND CLIENT DEMAND FOR HORTICULTURAL INFORMATION AND EDUCATION

A Dissertation

by

MONTE LYNN NESBITT

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Chair of Committee,	Philip W. Shackelford
Committee Members,	Gary E. Briers
	Scott R. Cummings
	Larry A. Stein
Head of Department,	Mathew Baker

December 2020

Major Subject: Agricultural Leadership, Education, and Communications

ABSTRACT

I assessed the demand in Texas for Extension education and problem solving in the subject of horticulture and the competency of County Agriculture and Natural Resource (ANR) Extension Agents employed by the Texas A&M AgriLife Extension Service (AgriLife Extension) to meet that demand with three research studies. Qualitative interviews with early-career agents revealed high motivation to answer external client questions and solve problems. Horticulture was the subject area that most early-career agents in our study felt vulnerable to manage and needed more competency training in. Horticulture Extension Specialists employed by AgriLife Extension expressed in one-to-one interviews that the demand for their expertise is either higher than when they were first employed or has always been high and has remained so. Based on client requests for meetings and site visits, commercial industry growth, and volume of emails and phone calls, the Extension specialists predicted continued high demand for horticulture expertise ten years into the future, and a great need for increasing the horticultural competency of both generalist County Extension agents and those county agents specializing in horticulture. Results from our electronic survey of 158 Agriculture and Natural Resource Extension agents showed that the external client demand for horticulture is significant in counties with populations of 80,000 and higher. ANR Extension agents in Texas on average agreed or strongly agreed (4.2 out of 5.0) with Horticulture Pro-Training, a Likert Scale we created measuring affinity for competency training, especially in the area of horticulture. Their mean scores on our Horticulture

Self-Sufficiency scale (3.5 out of 5.0) with S.D. of 0.47 indicated mixed opinions (agreement, disagreement and indecision) for learning the subject of horticulture on their own. We also found agents to be uncertain about where to find resources for horticulture and agricultural subjects in general, indicating a need for Extension leaders in Texas to increase web resource availability and visibility.

This dissertation follows the style of *Journal of Extension*.

DEDICATION

Graduate degrees are partially selfish pursuits. Oh yes, for married graduate students with children like me, the outcome is intended for the greater good of the family. The degree though, is awarded to an individual, not a married couple nor a family, as perhaps it should be! I regret all the things that Carol, Heath, Bryce and Collin Nesbitt endured during my second time in life as a graduate student, that took time and mental energy away from them—those greatest blessings in my life. I dedicate this work to Carol Rainey Nesbitt, for her strength, patience, grace and support. Carol, I love you so very much, and will never view this as an achievement I could have done without you. To Heath, Bryce, and Collin: Please know that it is never too late to change where you are in life and pursue Higher things. “Like arrows in the hands of a warrior are children born in one’s youth.” (Psalms 127:4) Boys, I love you!

ACKNOWLEDGEMENTS

I express here my deep gratitude to all my family who quietly and unwaveringly believed in my ability to start and finish this graduate degree. I appreciate very much the motivation, leadership and friendship I received from Dr. Larry Stein during pursuit of this degree. I am thankful to Dr. Philip Shackelford for serving as committee chair. It was wonderful to have both a friend and thoughtful leader as an advisor for this stretch of the road. Similarly, I extend gratitude to Dr. Scott Cummings and Dr. Gary Briers for serving on my committee. I am quite confident that I had the very best input for this work and effort.

I am thankful to those men and women who participated in the research studies presented in this dissertation. They include: early career County Extension agents from Districts 9 and 11, ANR agents from District 11 who participated in our survey pilot test, ANR agents at large in the state who participated in the main survey, and Extension Specialists and Extension Program Specialists in the Department of Horticultural Sciences (my friends and colleagues).

Above all else, I acknowledge my God, my Father in Heaven, my Lord and Savior Jesus Christ and the Holy Spirit that has imparted every ability and every enjoyment in this life to me and the life that is to come.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

I conducted the research and data analysis presented in this dissertation independently and under the supervision of my dissertation committee, consisting of Professor Philip W. Shackelford, advisor, Professors Scott Cummings and Gary Briers of the Department of Agriculture Leadership, Education, and Communications, and Professor Larry Stein of the Department of Horticultural Sciences.

Funding Sources

I obtained no grants, gifts, fellowships or other sources of extramural funding to conduct or evaluate the research presented in this dissertation.

NOMENCLATURE

AgriLife Extension	Texas A&M AgriLife Extension Service
BCE	Before the Common Era
CEA	County Extension Agent
CEA-ANR	County Extension Agent Agriculture & Natural Resources
CEA-FCH	County Extension Agent Family and Community Health
CEA-HORT	County Extension Agent Horticulture
DED	District Extension Director, Texas A&M AgriLife Extension
D-11	Extension District Eleven
Extension	National or State Cooperative Extension
RPL	Regional Program Leader, Texas A&M AgriLife Extension
TAMU Extension	Texas A&M AgriLife Extension Service
TAMU	Texas A&M University
TCES	Texas Cooperative Extension Service

TABLE OF CONTENTS

Page

ABSTRACT ii

DEDICATION iv

ACKNOWLEDGEMENTS v

CONTRIBUTORS AND FUNDING SOURCES vi

NOMENCLATURE vii

TABLE OF CONTENTS viii

LIST OF FIGURES x

LIST OF TABLES xi

1. INTRODUCTION AND REVIEW OF LITERATURE 1

Understanding Horticulture 1
Horticulture and Cooperative Extension 7
Competency of County Extension Professionals 12
Problem Statement 15
Theoretical Framework 16

2. TECHNICAL SUBJECT COMPETENCY NEEDS OF EARLY-CAREER EXTENSION AGENTS: A QUALITATIVE ASSESSMENT 18

Introduction 18
Problem Statement 20
Review of Literature 21
Research Purpose and Objectives 25
Methods and Procedures 26
Findings 29
Conclusions, Implications and Recommendations 41

3. EXTENSION HORTICULTURE IN TEXAS: PERCEPTIONS OF CLIENTELE DEMAND AND COUNTY AGENT COMPETENCY AMONG STATE EXTENSION HORTICULTURE SPECIALISTS 46

Introduction and Review of Literature 46
Theoretical Framework 50

Purpose and Objectives 51
Methods and Procedures 52
Findings 54
Conclusions, Implications, and Recommendations 73

4. ASSESSMENT OF THE REGIONAL, TENURE-ASSOCIATED, AND EXPERIENTIAL INFLUENCES ON HORTICULTURAL COMPETENCY AND RESOURCE UTILIZATION OF TEXAS COUNTY AGRICULTURE AND NATURAL RESOURCE EXTENSION AGENTS 77

Introduction and Review of Literature 77
Theoretical Framework 78
Problem Statement 80
Purpose and Objectives 81
Methods and Procedures 83
Findings 85
Discussion 126

5. CONCLUSIONS 131

Overview of Findings 131
Implications for AgriLife Extension 134
Recommendations for Research 137
Recommendations for Practice 141

REFERENCES 147

APPENDIX A. STATEMENT OF PURPOSE AND WORK INSTITUTED BY THE SMITH-LEVER ACT OF 1914. 156

APPENDIX B. TEXAS HORTICULTURE COMPETENCY SURVEY INSTRUMENT 161

APPENDIX C. IRB APPROVAL LETTER 186

APPENDIX D. MAIN SURVEY RECRUITMENT EMAIL 188

APPENDIX E. CURRICULUM VITAE, MONTE L. NESBITT 189

LIST OF FIGURES

Page

Figure 4.1. CEA-ANR Frequency of HortPro-Training Scores. 1=Disagree Strongly, 2=Disagree, 3=Neither Agree or Disagree, 4=Agree, 5= Agree Strongly. 122

Figure 4.2 CEA-ANR Frequency of Hort Self Sufficiency Scores. 1=Disagree Strongly, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5= Agree Strongly.....126

LIST OF TABLES

Page

Table 1. County Extension Agent Self-Assessed Technical Subject Proficiency and Deficiency....27

Table 2. Extension Horticulture Subject Matter Specialist Demographics; N=19 53

Table 3. Perceived Contribution of Extension Horticulture to the Mission of Texas A&M AgriLife Extension....55

Table 4. Extension Horticulture Specialists' Perceived Change and Reasons for Change in Client Demand for Horticultural Expertise 59

Table 5. Texas County Extension Agent Competency in Horticulture, as Perceived by State Subject Matter Specialists....64

Table 6. Subject Matter Specialist's Perceived Benefit of Training Two Types of County Extension Agents in Texas; N=19 66

Table 7. Justifications Given by Subject Matter Specialists for Training Two Types of County Extension Agents in Texas....66

Table 8. Texas CEA-ANR Current and Total Employment Tenure 86

Table 9. CEA-ANR Gender and Employment Tenure 87

Table 10. CEA-ANR Survey Participation by Administrative District of Employment .88

Table 11. CEA-ANR College Education in Horticulture; n=156 90

Table 12. CEA-ANR Informal Personal Experiences in Horticulture; n=156....91

Table 13. Texas County Population Reported by CEA-ANR (n=132) and by the U.S. Census Bureau (2019)....93

Table 14. CEA-ANR Rating of County of Employment Population Growth Trend; N=158 94

Table 15. CEA-ANR Perception of the Interest in Horticultural Information Among County Clientele, n=133 95

Table 16. CEA-ANR Perceived Change in Demand for Horticultural Information and Problem Solving in Present County of Employment, From Start Date (in current position) to Present Day, n=132 96

Table 17. One-Way Analysis of Variance, Comparing Perceived Change in Client Demand for Horticulture Among Seven County Population Classifications ... 97

Table 18. CEA-ANR Perceived Client Demand for Horticultural Information and Problem Solving for Seven Texas County Population Classifications 99

Table 19. Master Gardener Volunteer Distribution Among Surveyed CEA-ANR not Having a CEA-HORT on Staff 102

Table 20. CEA HORT Presence Versus County Population Estimate, n=22 103

Table 21. CEA-ANR Perceptions of the Contribution of a Master Gardener Program to External Client Horticultural Information and Assistance; n=59 105

Table 22. CEA-ANR Participation in Professional Development Trainings, n=157 106

Table 23. One-Way Analysis of Variance for Agency-Sponsored, External, and Distance Training Experienced by Texas ANR Agents 108

Table 24. CEA-ANR Preference for Professional Development Training; n=156 109

Table 25. Usual First Method and All Methods Used by ANR Agents for Managing Client Horticultural Questions or Problems; n=133 111

Table 26. *Subset 1*-CEA-ANR Perceptions and Attitudes Toward Technical Subject Matter Competency and Organized, Agency-Led Training Programs; N=158 113

Table 27. *Subset 2*-CEA-ANR Perceptions and Attitudes Toward Competency and Organized, Agency-Led Training Programs in Horticulture; n=133 117

Table 28. *Subset 3*-CEA-ANRPerceptions and Attitudes about Supportive Resources that Offset Technical Subject Matter Competency; n=132 120

Table 29. *Horticulture Pro-Training* Likert Scale 121

Table 30. One-Way Analysis of Variance of Horticulture Pro-Training Scores for CEA-ANR Previous Personal Horticultural Experience 123

Table 31. *Horticulture Self Sufficiency* Likert Scale 125

1. INTRODUCTION AND REVIEW OF LITERATURE

Understanding Horticulture

Horticulture, the practice of cultivating garden plants, has ancient historical roots. Human beings have quite possibly always been opportunistic users of a wide array of plants for food and medicine. Humankind's transition from a nomadic, hunter-gatherer lifestyle that included browsing of many types of plants to a more situated or settled life that included deliberate cultivation of fewer plants, is believed to have begun during the Neolithic Age and progressed slowly over thousands of years (Von Baeyer, 2010). Horticultural techniques, tools, and species of plants have multiple cultural centers of origin, but purposeful irrigation practices and formalized gardens or orchards laid out in rows and enclosed within home boundaries can be dated to at least 3,000 BCE (Before the Common Era) and attributed to the Sumerians (Von Baeyer, 2010). Successful cultural practices of practical plants emerged over thousands of years in many civilizations, and were shared and passed forward to successive generations through oral traditions, tales, herbals, almanacs, folklore, and histories (Janick, 2007).

The increases in knowledge over time of how to grow plants for food and medicine ultimately led to gardening for aesthetics in advanced civilizations. Hans Vredeman de Vries, a Dutch architect and painter, published one of the first artistic garden design manuscripts in 1583, entitled *Hortorum Viridariorumque elegantes,* which depicted

formal, intricately ornate, and grand-scale gardens. De Vries can be considered one of the first persons to bring the association of gardens and art to the human conscience (Perry, 2002). Gardens, for either function or aesthetics (or both), evolved over successive generations according to geography, climate, cultural influence, and introduction of new/non-native plants. Monticello, the plantation home of U.S. President Thomas Jefferson, had a large terraced garden known to "mainly serve the functional needs of the plantation," but also as a site for entertaining guests with beautiful views (Leuchtman, 2019).

Horticulture as a formal and distinct scientific discipline emerged from the shadows of traditional sciences like botany, chemistry, and medicine through key contributions of eighteenth and nineteenth-century scientists. Carl Linnaeus, a Swedish botanist, developed the binomial system of plant classification in 1735, and also contributed importantly to the knowledge of plant provenance and adaptation to non-native growing regions (Stearn, 1976). German chemist Justus von Liebeg provided understanding of essential plant elements and artificial fertilizer efficacy through his "Law of the Minimum" around 1860 (Kyle & Shampo, 2001). Gregor Mendel's breeding of pea plants in 1862 and revealing of genetic inheritance phenomena were a foundation for systematic breeding of horticultural crops that continues today (Miko, 2008). These and other contributions provided a scientific base for horticulture to be considered more than just plant husbandry.

From these advances in the foundational science underpinning horticulture and the ongoing plant exploration and development of important breeders like Luther Burbank (1849-1926) and plant nurserymen like William Prince Sr., who founded the first commercial nursery in the United States near Flushing, NY, around 1750 (Fusonie, 2020), horticulture became a hobby, vocation, and profession. *The Royal Horticultural Society*, formed in London, England, in 1804, is an important progenitor of horticultural special interest groups purposed to improve the diversity and availability of edible and ornamental plants (Janick, 2008). Similar societies appeared in the United States, including the *American Pomological Society*, founded in 1848 for the study of fruit plants and trees (Janick, 2007), along with many other local, state and regional groups. The *American Society for Horticultural Science*, which fosters collegiality and scientific exchange among American and international higher education institutions today, was co-founded in 1903 by Liberty Hyde Bailey, a professor of horticulture at Cornell and important writer of scientific horticultural manuscripts. Bailey, who by testament of his important literary contributions, horticultural research and lectures on the subject throughout the country, is widely considered the "Father of American Horticulture" (Connors, 2012).

Liberty Hyde Bailey is also among the early professors or instructors of horticulture in American colleges and universities. He received a bachelor's degree in botany at Michigan State University (originally named Michigan State Agricultural College), and after subsequently working for Asa Gray, the accomplished director of the Harvard

Botanical Garden (Perry, 2002), became the first chair of the new Department of Horticulture and Landscape Gardening at Michigan State in 1885 (Connors, 2012). The appearance of college departments that taught horticulture accelerated in the U.S. under the Morrill Act of 1862, which provided for the endowment, support, and maintenance of at least one college in every state that would teach "agricultural and mechanic arts" (Higher-Ed.org). Iowa was the first state to accept the terms of the Morrill Act, and use funds to support an existing institution, while Kansas in 1863, was the first state to create a new "land-grant institution" (The National Schools of Science, 1867). The first horticulture classes at Iowa State University (originally named the Iowa State Agricultural College and Model Farm) were taught in 1869 (Hall, 2020). Kansas State University (originally Kansas State Agricultural College) had a horticulture professor (Reverend Elbridge Gale) and an independent budget for horticulture teaching and experimentation in 1870 (Marr, 2013). Texas A&M University (originally named the Agricultural and Mechanical College of Texas), which also developed under the Morrill Act, began teaching in 1876. Horticulture was part of that early instruction in the "Department of Agriculture and Scientific Courses." A stand-alone department of horticulture was organized in 1892 and led by Robert H. Price (Lineberger, 2020).

Horticultural science and technology in the present era encompasses the botany and production systems of a broad array of plants, grouped into subspecialties for fruit, vegetables, floriculture, ornamental horticulture, herbs, spices, and medicinal plants (Janick & Goldman, 2003). Large, commercial horticultural industries in all the

subspecialty groups have become increasingly reliant on horticultural science and technology in the last sixty years to maintain profitable production (USDA-NIFA, 2020c). Worldwide fruit, vegetable, and spice production in 2018 was estimated at 6.3 Billion metric tons (FAO-UN, 2020). Landscape design, installation, and maintenance for residential and commercial entities, and all of its associated production support industries (nurseries, equipment, greenhouses, fertilizers, crop protection, etc.), termed the "green industry" represent a sales revenue contribution to the U.S. economy of $136.44 billion dollars (Hodges et al., 2015). Home horticulture is considered the most popular hobby in the U.S., contributing $35 billion to the national economy in 2012 alone (USDA-NIFA, 2020c).

The importance of horticulture and need for horticultural expertise in society today are manifested by many indicators beyond economic impact. Increased awareness of the positive contributions of many horticultural crops to human nutrition has increased demand for locally-grown and sustainably-produced foods, including fruits and vegetables (Rubatzky & Yamaguchi, 2012). Mental health and well-being is positively-impacted by the availability of public botanic gardens, parks, sports fields, and even individual home gardens (Hall & Dickson, 2011). Botanical gardens and zoos enjoy more visitors than the combined annual attendance at sporting events in the United States (Lauby, 2006). Properly designed and maintained landscapes can provide favorable environmental impact by altering energy use, biodiversity, carbon sequestration, reducing storm water runoff, and improving water quality (The

Pennsylvania State University, 2009). Volunteer and charitable participation in community gardens and food kitchens is an important and growing social outreach activity believed to increase community ties and reduce the severity of food deserts in urban, low-income areas (Demuro, 2013). The Extension Master Gardener program, which provides horticultural education to people who in turn provide gardening-related service and education to their communities, is one of the largest volunteer organizations in the U.S., with 86,076 volunteers in forty-nine states (Extension Master Gardener, 2020).

Horticulture is an important agricultural subject in Texas given the population growth and importance of gardening as a recreational pastime in the United States (Brashier et al., 2006). According to the U.S. Census Bureau (2019b), Texas had the highest population increase in the country from July 2018 to July 2019, adding an estimated 367,215 people. New home construction in Texas was also the highest in the U.S. in 2019, accounting for 14.86% of the national total (U.S. Census Bureau, 2019a). A survey of seven states demonstrated that landscapes that improve their aesthetic contribution from “average” to “excellent” increase home values ten to twelve percent (Niemera, 2016), therefore, it can be expected that population growth areas will experience concomitant increase in demand for horticultural information and problem solving.

Horticulture is important in Texas beyond home beautification and gardening. The total annual economic contribution of the "green industry" in Texas, canvassing nursery and greenhouse production, florists, landscape architectural services, lawn and garden equipment and supplies, etc. was estimated at $19.5 billion dollars in 2018 (Palma & Hall, 2019), an increase of $700K per year compared to 2015 (Palma & Hall, 2016). Horticultural crop production industries, including fruit and vegetables, are also important. The 2017 USDA Census of Agriculture reported that Texas held 176,837 acres in orchard production and 97,648 acres in vegetable production, ranking fifth and thirteenth in the nation, respectively (USDA-NASS, 2017).

Horticulture and Cooperative Extension

Considering the collective societal demand factors for horticultural crops and recreation, horticultural expertise is indispensable in our world today (Meyer et al., 2016). The amount of public information available on the internet, television, radio, or in print is higher than it has ever been (University of Tennessee Institute of Agriculture, 2020), yet this abundance does not lessen the need for situational education (consulting) and problem solving. Cooperative Extension agencies have had some responsibility and opportunity to provide research-based information and problem solving for horticulture at the local, state, and federal level since the passage of the Smith-Lever Act in 1914 (Higher-Ed.org). The language of the Smith-Lever Act paved the way for horticultural expertise and non-college student support by stating that its purpose was "diffusing

among the people of the United States useful and practical information on subjects related to agriculture, home economics and rural energy" (Sec.1, Table 1, Appendix A). Smith-Lever further stated Extension work should consist of "the development of practical applications of research knowledge and giving of instruction and practical demonstrations of existing or improved practices or technologies in agriculture, home economics, and rural energy, and subjects relating thereto to persons not attending or resident in said colleges in the several communities" (Sec. 2, Table 1, Appendix A). Public assistance, in the form of practical information (education) and outreach under Smith-Lever, was to be "in connection with" the 1862 land-grant institutions funded by the Morrill Act, the nineteen predominantly African American universities funded by the second Morrill Act of 1890 (USDA-NIFA 2020a), and the tribal colleges funded by the 1994 Land Grant Act (USDA-NIFA, 2020b).

The Cooperative Extension Service established under Smith-Lever had a federal component (USDA) funded to provide "administrative, technical, and other services, and for coordinating the Extension work of the Department and the several States, Territories, and possessions" (Higher-Ed.org). Each state and U.S. territory (Virgin Islands, Guam, and the Northern Mariana Islands) received congressionally appropriated funds to execute the Extension mission according to a 20%, 40%, 40% funding stipulation (Sec. 3 Table 1, Appendix A). Twenty percent of the funds were distributed equally among the states, and two forty-percent portions were distributed based on each state's representation in the total U.S. rural and farm populations, respectively (Sec. 3.

Table 1, Appendix A). To receive the federal funds, states had to appropriate equal funds from non-federal sources. This federal act then allowed Extension agencies to be established and organized under their own, respective, state administrative body.

Texas developed a county-based strategy for Cooperative Extension work that actually pre-dated the Smith-Lever Act. William C. Stallings, the nation's first county agent, began work in Smith County, Texas, in 1906 (May, 2010). The hiring of Stallings is believed to have been influenced by the work of Seaman A. Knapp, whose boll weevil demonstration farm in nearby Kaufman County, Texas, and recruitment of farmers for additional boll weevil trials, brought practical and influential farm assistance to Texas farmers (Minor, 2010). As the Smith-Lever Act funding came into existence, the Texas Legislature passed laws authorizing the county commissioners' courts to provide and fund offices and conduct Extension work in agriculture and home economics with Texas A&M (May, 2010). Texas counties continue to support local Extension today by provisioning of offices, operating budgets, personnel travel, etc., with funds controlled by each county commissioner's court. Therefore, Cooperative Extension in Texas, now operating under the name Texas A&M AgriLife Extension Service (AgriLife Extension), is funded through a combination of county, state and federal funds; a system that it leverages to cultivate partnerships and resources such as contracts, grants and user fees (Office of the Governor, Texas Budget Division and the Legislative Budget Board, 2018)

Horticulture is visible in early accounts of county Extension work across the country. The 1939 *Extension Service Review* presented highlights of activities of a "Who's Who Among the First Agents", to give perspective of the careers of five county agents who had worked in extension for at least 25 years. Three of those agents and their work is described as follows:

> A.F. MacDougal (county agent in Middlesex County, MA); "The fruit section of the county has been developed in such a way that the area is one of the best-known fruit sections in the East."
>
> Elbert Gentry (county agent in Smith County, TX); "Mr. Gentry is going strong with nearly seven thousand farmers with an agriculture that varies from the rose industry to permanent pastures."
>
> R.H. Stewart (county agent in Box Elder County, UT); "Other problems of major importance in our county that we have attacked are the establishment of 4-H club work, control of rodents and noxious weeds, landscape gardening of public and private grounds, buildup of the poultry business, establishing two cooperative marketing and grading plants and adoption of improved orchard practices" (Schlup, 1939).

The Victory Garden programs of World War I and World War II is an important example of Cooperative Extension playing a significant role in a national horticulture-program. Twenty million family victory gardens generated approximately forty percent of the total national production of vegetables in 1944 (Moore, 2019). Because many people raising victory gardens during the wars were new to growing vegetables,

Cooperative Extension agents, specialists and leaders assisted the program in the form of production pamphlets, newspaper articles, local demonstrations and provisioning of 4-H clubs for youth involvement in the wartime effort (Schaub, 1914).

County Extension agents never conducted their work entirely alone. In the same way that it happened in other states, subject matter specialists were hired by Texas' first Extension director, Clarence Ousley, for plant pathology, animal science, dairy science, agronomy, poultry science, horticulture, and agricultural engineering (May, 2010). The specialists worked alongside the agents in demonstration efforts to encourage planting of new crops or encourage adoption of new techniques. For example, "In 1916, the county agent of Henderson County, Texas, and the specialist in horticulture of the Extension staff at the agricultural college put on a series of demonstrations throughout the county in pruning and spraying peach orchards" (Knapp, 1920). Depending on the state, Extension program delivery and outreach assistance today continues to be a mutual and coordinated effort of local field agents (county, multi-county or in cluster teams) and regional or state specialists.

Over the course of time, some state Extension agencies experienced enough demand for horticulture to place horticulture agents in counties or regional offices. AgriLife Extension responded to increasing demand for horticulture assistance in the state by staffing twenty-four counties with an Extension horticulture agent, beginning with Travis County, Dallas County and the other urban centers. The demand for horticultural

information however is not limited to these twenty-four counties, and thus there are an additional 226 counties whose county horticultural problems and requests for information are managed by an agriculture and natural resources agent (CEA-ANR) who must stay abreast of horticulture and all other agricultural subject areas. Counties adjacent to urban counties in Texas reflect the findings of Lawrence (1988) who demonstrated increasing demands for information on horticultural specialty crops in those counties adjacent to major urban centers.

Competency of County Extension Professionals

The word *competency* is defined in Meriam Webster online as 1) "having sufficient knowledge or skill", and as 2) "a specific area of competence". Many professions have established competencies for individuals wishing to practice in the profession. These competencies may be suggested, as determined by group of practicing professionals like those developed for health care professionals (Greiner & Knebel, 2003), or enforced by a testing-based certification program, like those developed in each state for school teachers. Certified public accountants are licensed by passing a rigorous exam, coursework participation and gaining on-the-job experience (The Association of International Certified Professional Accountants, 2020). For businesses and corporate entities, defining employee competencies can facilitate strategic planning and human resource decisions by clarifying the knowledge, skills and behaviors needed in the future and by serving as a foundation upon which to build employee selection, training,

professional development, performance appraisal, and succession planning (Stone & Bieber, 1997).

One of the recognized problems facing Extension nationally is employee turnover from voluntary separation (*Extension Committee on Organization and Policy, 2005 Report*, 2005). The job of a County Extension agent is demanding from the standpoints of time commitment, interaction with diverse adult audiences and youth groups, local committee involvement, reporting and accountability, and travel requirement. Brodeur et al. (2011) states that job satisfaction is central to the problem of Extension employee turnover, and that not believing in one's own ability to do the job well (to be competent) is central to job satisfaction. The Arkansas Cooperative Extension Service, from a survey of Extension agents and agent supervisors, proposed seven competency domains related to county agent success, including: faculty/staff relations, work habits, public relations, program planning, implementation and evaluation, personal and professional development, personal skills, and management responsibilities(Cooper & Graham, 2001). A Texas Extension competency model, proposed from focus group studies and interviews with extension faculty, identified six competency domains, including: subject matter expertise, organizational effectiveness, development and involvement of others, communications, action orientation, and personal effectiveness (Stone & Coppernoll, 2004). The diversity in competency domains shown by these two studies alone reveals what is widely known about the Extension profession. It is multi-faceted, challenging

and deserving of a comprehensive organizational strategy for employee training and support.

The positive career motivator with the highest frequency of agreement in a survey of extension professionals in Colorado was “opportunity to make a difference in the lives of others” (Harder et al., 2014). County Extension agents and specialists alike certainly have the opportunity to make a difference in the lives of others from the high number of contacts with external clientele afforded to them. In fact the vision statement of AgriLife Extension (2020) is “help Texans better their lives.” County agents are at the forefront of Extension clientele interaction (Bailey et al., 2014), and they are charged with satisfying that clientele with their own subject matter expertise (competency) or identifying and delivering resources that will satisfy or assist that clientele and even make a difference in their lives. The previous description of the “major problems of importance” that R. H. Stewart “attacked” from 1914 to 1939 as a Box Elder County, Utah, Extension agent reveals much about the challenge faced by County Extension educators. Extension clients, in the agriculture sector alone, have very diverse needs for information and assistance, from livestock production, to rangeland improvement, row crop production, wildlife management and many others. Horticulture is an example of an agricultural science that many County Extension agents in Texas may have limited formal training in, unless their college major or minor emphasis was in horticulture. This lack of training may affect their competency and ability to satisfy client needs in that subject area. The popularity of horticultural pursuits and requests for information from non-commercial

stakeholders puts additional demands on an already-stretched Extension system (The Pennsylvania State University, 2009).

Problem Statement

AgriLife Extension and other state Extension systems needs innovative employee training programs that raise competency across several domains. One important competency domain is technical subject matter expertise. In the absence of an internal, agency-sponsored program for county extension agents to gain or raise their expertise in subject areas like horticulture while on the job, three problematic outcomes for extension education delivery in Texas are possible:

1) The quality of client service and programmatic offerings available in some county offices may not meet expectations set by Extension administration or its clients, negatively impacting partnerships and support.
2) Inadequate technical subject matter competency not raised through agency-sponsored employee training may increase job frustration and dissatisfaction for some extension agents. Inability to make a difference in peoples' lives and insufficient opportunities for personal and professional growth may lead to a higher Extension professional turnover rate.
3) High Extension professional turnover rates diminish the fiscal integrity of the Cooperative Extension Service through lost wages, increased hiring costs,

and discontinuity in relationships potentially contributing to extramural and political support.

The growth in demand for recreational and commercial horticulture throughout Texas supports the need for the AgriLife Extension to assess competency of Texas county extension agents in the subject area of horticulture and to develop professional development strategies that can maintain competency in this subject area, while also favorably contributing to both employee retention and client satisfaction.

Theoretical Framework

The Service-Satisfaction Model for Extension described by Terry and Israel (2004) is used as a guiding framework for this research study. The model establishes the relationship of agent performance to end-user (Extension client) satisfaction. The perceived service relevance and accuracy is key to favorable client satisfaction outcomes. Agent performance, agent experience and agent availability influence the perceptions of service relevance and experience. Client attributes also have an important role. Those attributes include age, gender, education and work status, all of which have a bearing on the types of problems and needs for information that drive their interaction with cooperative extension. The service-satisfaction model is influenced by the Service-Profit Chain (Heskett et al., 1994), a model for corporate business success that establishes a relationship between employee satisfaction and customer satisfaction. Corporate entities like Southwest Airlines have used the service-profit chain model to

create fiscal profitability and growth by making employee care a priority. Employee loyalty is then manifested in customer service, which in turn raises customer satisfaction and loyalty (Heskett et al., 1997).

This dissertation comprises three studies formatted/presented as three journal articles titled as follows:

1. Technical subject competency needs of early-career Extension agents: A qualitative assessment
2. Extension horticulture in Texas: perceptions of clientele demand and county agent competency among state extension horticulture specialists
3. Assessment of the regional, tenure-associated, and experiential influences on horticultural competency and resource utilization of Texas county agriculture and natural resource extension agents

2. TECHNICAL SUBJECT COMPETENCY NEEDS OF EARLY-CAREER EXTENSION AGENTS: A QUALITATIVE ASSESSMENT

Introduction

The original mission of state cooperative Extension agencies to educate non-college students in agriculture and home economics through instruction, field demonstrations and publications is contained in the Smith-Lever Act of 1914 (Higher-Ed.org). More than one hundred years later, this basic mission has expanded to include instruction in areas of "youth and adult life skills, human and capital leadership and community economic development" (Texas A&M AgriLife Extension Service, 2017). The Smith-Lever Act mission is executed by the nation's Land Grant System University System which includes participating 1862 public universities, 1890 traditional black colleges (including Tuskegee), and 2004 tribal colleges and universities (USDA-NIFA, 2017). AgriLife Extension serves in this capacity for Texas with one of the nation's largest state Extension systems, operating 250 county Extension offices and employing approximately 900 county-based and statewide educators (Texas A&M AgriLife Extension, 2017).

As with any private business, corporation or government agency that manages large numbers of employees, employee retention, professional development and promotion within Extension are important management foci. Extension agencies are unique in that

they deliver; unbiased, research-based information that solves or prevents problems and positively directs the health and economic well-being of a very diverse clientele. County-based Extension educators (AKA "County Extension agents") are at the forefront of that clientele interaction (Bailey et al., 2014). They are charged with satisfying that clientele with their own competency or identifying and delivering resources that will satisfy them. Their job satisfaction (and thus their retention as Extension employees) is tied to many factors, including but not limited to their opportunity for professional development and their effectiveness at making a difference in peoples' lives (Harder et al., 2014). Extension systems have used these findings and others to develop many different employee training and development models (Garst et al., 2007; Stone & Coppernoll, 2004).

AgriLife Extension, as with other state Extension systems, continues to explore ways to develop, promote and retain educators. For new and early-career agents, a step-wise integration of Extension program competencies is given in three agency-sponsored training steps: *mentoring*, *onboarding*, and a *program excellence academy* (Organizational Development, Texas A&M AgriLife Extension Service, 2017). These training efforts are geared to train agents in the fundamentals of client interaction, administrative functions, program planning/delivery, and impact reporting. They are not used for technical subject competency development.

Problem Statement

AgriLife Extension, as with other state Cooperative Extension systems, needs innovative employee training programs that raise competency across several domains. One important competency domain is technical subject matter expertise. In the absence of an internal, agency-sponsored program for county Extension agents to gain or raise their expertise in subject areas like horticulture while on the job, three problematic outcomes for Extension education delivery in Texas are possible:

1) The quality of client service and programmatic offerings available in some county offices may not meet expectations set by Extension administration or its clients, negatively impacting partnerships and support.
2) Inadequate technical subject matter competency not improved through agency-sponsored employee training may increase job frustration and dissatisfaction for some Extension agents. Inability to make a difference in peoples' lives and insufficient opportunities for personal and professional growth may lead to a higher Extension professional turnover rate.
3) High Extension professional turnover rates diminish the fiscal integrity of the Cooperative Extension Service through lost wages, increased hiring costs, and discontinuity in relationships potentially contributing to extramural support.

The growth in demand for recreational and commercial horticulture throughout Texas supports the need for AgriLife Extension to assess competency of Texas county

Extension agents in the subject area of horticulture and to develop professional development strategies that can maintain competency in this subject area, while also favorably contributing to both employee retention and client satisfaction.

Review of Literature

Extension in all state land grant systems faces changing clientele needs, an erosion of its classical rural farm education niche and a need to redefine its purpose (West et al., 2009). The success of Extension agencies is dependent on having highly qualified agents in contact with local people (Cooper & Graham, 2001). County Extension agents interact with the public and news media frequently, requiring that they be knowledgeable in various scientific disciplines and know where to find information for clients (Radhakrishna & Thomson, 1996). In Texas, most County Extension agents are delineated as "Food and Community Health Agents" (FCH), Youth Development (4-H) or "Agricultural and Natural Resource Agents" (ANR). All three categories of Texas county agents must stay abreast of a wide variety of technical subjects and scientific disciplines, especially those ANR agents who are asked to assist agricultural producers and homeowners alike with questions about animal husbandry, wildlife and range management, soil science, water resource management, agronomic crop production and horticulture.

Horticulture, a discipline that is interwoven historically with Extension, has become an increasing focus for Extension both in urban and rural counties in some states. A 1991 survey of Extension agents in Maryland predicted an increase in programming needs in two years in the area of home horticulture for 91% of that state's counties (Healy, 1991). Texas, like other states in the United States., has experienced significant urban population growth. In the early 1990's, the Texas Agricultural Extension Service (now *Texas A&M AgriLife Extension Service*) instituted an "Urban Initiative" in six metropolitan counties that accounted for nearly 50% of the total state population at that time (Fehlis, 1992). The initiative was expanded to a seventh county (Williamson) since that time and included increased staffing and diversity of expertise to meet the demand for information and problem solving. The seven urban counties in Texas have one or two County Extension agents who work solely in the area of home and or commercial horticulture. An additional seventeen counties throughout the state also have a County Extension agent for horticulture, based on perceived clientele need and support of the state agency and county government. The high demand for horticultural information is not limited to these 24 counties. Counties adjacent to urban counties in Texas reflect the findings of Lawrence (1988) who demonstrated increasing demands for information on horticultural specialty crops in those counties adjacent to urban counties. Gardening is an important recreational pastime in the United States (Brashier et al., 2006), and Cooperative Extension must strive to be a relevant source of research-based information for home horticulturists and gardeners.

County agents need and seek information for client questions, presentations, program planning, grant research, professional development and research projects (Bailey et al., 2014). Horticulture accounted for 7.5% of client-driven inquiries to Extension agents in a 1991 survey conducted in Illinois (Shih & Evans, 1991). Extension agencies must provide horticultural information resources to those county Extension agents who were not formally educated in that scientific discipline. County agent reliance on specialists within horticulture or other disciplines to provide subject matter-related information was approximately 70% of oral information sources and Extension bulletins accounted for 40% of written information sources (Shih & Evans, 1991). The availability of Extension specialists in Texas to service the information needs of county agents in all 250 county Extension offices is limited because of travel and personnel budget constraints, thus Internet/web-based sources of information have become increasingly important.

Large Extension agencies like AgriLife Extension may be able to expand and improve agent competencies through internal training and professional development. Training can be provided in many formats (self-directed, distance taught, cohort training, etc.), but all formats require time devotion and in some cases travel, by the trainees, administrators and content specialists. The perceived value of training may vary among those respective parties, thus it is important to fully identify training priorities and delivery methods with a thorough agency needs assessment (Baker & Hadley, 2014). Such an assessment for agent competency and training in horticulture has not been previously conducted by the AgriLife Extension Organizational Development Unit, but

new efforts have been undertaken (Shackelford, 2016). An evaluation of new agent competency development in Kansas found that programs offered early in the career of new agents, that offered an on-line component and included networking with other agents were deemed valuable (Baker & Hadley, 2014).

Certificate programs have been proposed as one approach to increasing Extension agent competency for a particular technical subject without them having to leave their position with Extension to pursue that competency through outside formal education (Bailey & Deen, 2007). On-the-job opportunities for increased competency, coupled with increased opportunity for promotion may lead to better employee retention. Retention of experienced agents is a priority to Extension systems, which is challenged in part by competing financial opportunities in the private sector during periods of economic growth (Young et al., 2013). A small, national pilot study of fourteen 4-H/youth development apprentices receiving certificates through a mentor-directed on-the-job training program revealed a theme of improved job interest and enthusiasm among participants (Bailey & Deen, 2007). Post-test evaluations of this same pilot group showed a significant increase in their belief of an opportunity to be promoted in their present Extension careers. A formal, Extension agent certificate program in the area of horticulture could be a strategy AgriLife Extension Service deploys to increase agent competency for home and commercial horticulture clients, while also raising job interest and employee morale.

Research Purpose and Objectives

A certificate program for increasing Extension agent competency in horticulture science was developed as a pilot project to evaluate in the "Southeast Region", one of AgriLife Extension's six administrative regions. The program was developed by Extension faculty in the Department of Horticultural Sciences and the Department of Agricultural Leadership, Education, and Communications at Texas A&M University, as a customized approach for professional development in horticulture. It included six topical training modules (tree fruit, viticulture, vegetables, trees/landscaping, turfgrass, and master gardener management), each taught by Extension faculty in eight-hour workshop formats with in-class lecture and hands-on demonstrations (Shackelford, 2016).

The purpose of the study reported here was to help validate and support expanding this pilot training as a state-wide Extension agent training program through qualitative assessment of the first cohort of trainees. The research objectives were to: 1) thickly describe how early-career Texas county Extension agents (less than five years of service) feel about and value answering client questions, personally approach their technical subject matter competency, and perceive incentives, opportunities and obstacles to mastering certain subjects, and 2) determine perceived importance of horticulture competency among Texas County Extension agents not formally trained in horticulture. I pursued these objectives with pre-training, one-on-one interviews with early-career Extension agent/trainees in the first cohort.

Methods and Procedures

Twelve Texas County Extension agents from the Southeast Region (districts 9 & 11) were selected to participate in a pilot horticulture certificate program conducted in 2017. They represented 12 different counties in the "Southeast" administrative region, and were serving the agency with the job title of "County Extension Agent-Ag & Natural Resources." None of the twelve counties in this sampling frame captured the large, urban cities of this region and can be thought of us as "traditional agricultural counties" with collections of small to medium-sized cities. Each participant was nominated by their District Extension Director and approved by the Southeast Regional Program Leader to participate. Unless a personal or job-related hardship arose for a nominated individual, they were directed to participate in the program by their administrators.

I purposively drew a research sample from the twelve participants in the pilot horticulture program. Due to scheduling conflicts, only ten of the twelve participants took part in research activities. We determined that one of those ten agents was new to his present position, but had much longer previous Extension career experience interrupted by a period of private industry employment. We therefore excluded him from data analysis. A second participant had an Extension employment tenure of 7.5 years, which was above our definition of "early career" established for this study. The remaining eight participants had a career tenure of 33 months or less (Mean of 23.5

months), thus the data analysis we present here was restricted to 8 of 12 individuals with similar, early-career experiences and perceptions (Table 1). Two of eight participants had 10-week, full-time internships prior to their full-time employment, which is counted toward their service time in this assessment. One participant worked as an assistant agent for 12 months, which was counted as relevant experience in this study. All eight participants held a college bachelor degree in either general agricultural studies or a specific scientific discipline, such as agricultural economics or animal science. Six of eight held either a master of science or a master of agriculture degree, also in a general agricultural development/leadership program or in an agricultural science discipline. Four participants were female and four were male.

Table 1. County Extension Agent Self-Assessed Technical Subject Proficiency and Deficiency

Par-ticipant	Extension experience (months of full-time employment, including any full-time assistant agent or internship postions held)	Self-assessed estimated percentage of client questions (all subjects) answered without assistance	Technical subject area most challenging to provide answers to client questions	Preferred technical subject to gain competency in that would benefit county clients
P1	25	75%	1) Horticulture 2) Pesticides	Horticulture
P2	14	25%	1) Horticulture 2) Arboriculture	Horticulture
P3	28	50-60%	1) Livestock 2) Row crops	Animal Science
P4	30	75-80%	1) Horticulture 2) Viticulture	Horticulture
P7	30	70-85%	1) Horticulture 2) Plant Pathology	Horticulture
P8	22	40-50%	1) Horticulture/plant ID & selection, 2) Range & Pasture /brush control	Animal Science
P9	5	50%	1) Horticulture—homeowner issues	Horticulture
P10	33	90-95%	1) Ornamental horticulture, lawn care, trees, plant ID, pests	Range Management

I conducted one-to-one interviews before the start of the first class session with each of eight study with Web-Ex conferencing software (Cisco Systems) to allow audio recording of each interview. I asked fourteen questions, following a semi-structured style that allowed for naturalistic inquiry and opportunity for discussion beyond the structure and order of the questions. I coded responses from field notes and WebEx recordings, and performed a constant comparative analysis to elucidate themes from five main research questions addressed in the data.

Credibility of this study was built upon 1) conducting the interviews by distance technology from each person's office, allowing interviewees to be in their most familiar/comfortable work setting during the interview. 2) The interviewer, who was a fellow employee of the AgriLife Extension, approached the interviews from a "co-worker's perspective" with a conversational approach to the questioning. 3) The recording process likewise was not intrusive, with each participant familiar with the WebEx software and its integrated recording tools. Triangulation of this research study was provided by having more than one researcher review and analyze the data. I provided peer debriefing memos to Dr. Shackelford, the lead researcher from an audit trail.

The study results should be transferable to other Extension agencies with early-career agents. Based on socio-agricultural dynamics found in Texas, the results are most transferable to other counties in Texas, which follows the same Extension administrative structure, hiring principles and organizational development methods throughout its six

regions. Transferability to other state Cooperative Extension systems is aided by the diversity in life experience, background and training of the eight individuals that were studied. For those other states that utilize a single Extension agent to canvas a wide geographical area (counties, regions, etc.), and/or stay abreast of diverse agricultural information, the experiences and perceptions of these eight individuals should be transferable to efforts aimed at improving Extension program development, delivery and client satisfaction.

Findings

Research Question 1. What life experiences outside of college education contribute positively to serving as a county Extension agent?

All eight participants were involved in 4-H or FFA (or both) in their pre-college years and cited those involvements as influential to their career choice and helpful in their early work as an Extension agent. P3 stated:

> The first thing that came to my mind was 4-H. I was a shy kid growing up, but being in 4-H, and having the dad that I did (who was an Extension agent and 4-H leader) forced me into public speaking, into learning about marketing, meeting people, shaking hands, making eye contact.

Three participants described themselves as a "people person" (e.g. socially outgoing), and connected their childhood involvement in youth Ag programs to their present ability to relate well to people in their public servant careers.

Exposure to some form of family farming activity or agribusiness was also relevant to the Extension careers of these study participants. Seven of eight participants lived on or near a farm owned or leased by their family. The eighth participant, who did not have actual "family farming" experience, was influenced by her grandfather, who was a vocational agriculture school teacher and very engaged in youth livestock and judging programs. The scope and type of family farming experience varied with each participant. Some agents continued to have some engagement with those family farms or their own farms at the time they were interviewed. P9 for example, presently owns and operates her own cattle herd on her family's farm. These "farm life" experiences appear to give early career Extension agents a head start toward recognizing and solving problems for their clientele. P3 explained:

> All the things I did, how I grew up, what my parents were doing, I draw on those experiences. When I don't know the scientific answer to something that comes up, I am able to make inferences based on my experience.

Participants reflected on help that they believed they gained from other general agricultural work experiences. P10 described his job experiences with a feed store, in the local livestock sale barn, as a horse trainer, and in hay production as collective informal educational experiences that "gave me tremendous hands-on experiences that I am still drawing from as an agent". It is not uncommon for County Extension agents to have some career experience in public education as vocational agriculture (Vo-Ag) teachers. In this sample, three of eight participants left Vo-Ag teaching jobs to become Extension

agents. They each described their teaching experience as useful to their Extension agent careers in the areas of public speaking, youth engagement, volunteer management and program delivery.

Research Question 2. A.) What things do agents value in their jobs? B.) What emphasis do agents place on subject matter competency? C.) How competent do they feel now overall? and D.) What technical subjects give them problems?

The second research question had four sub-components to its line of questioning. First, I asked participants what things they enjoyed and valued about their jobs as County Extension agents. Six of eight used one of the following phrases: "solving problems for adults," "helping people," "providing direct help to landowners," "being able to help," "helping somebody with a new problem," or "helping people expand." P9 did not describe 'problem solving' per se, but did explain, "I just love being able to work with other people and being in constant communication with the public." P7 stated that he liked "interacting with my Ag producers and watching their progress." Another common response theme to this question was that Extension agents thrive on the situational and circumstantial variety that Extension work brings to them daily. P8 said, "The biggest thing I like about Extension is that it is different every day." The words *new things* or *variety* were described as a positive aspect of a county agent's job by seven of eight participants.

I next asked participants to describe the importance they place on answering technical subject-related questions themselves for their clientele. The responses from seven of eight participants included the following phrases: “it’s very important; I take it seriously,” “it’s important to be able to help them,” “definitely important--it’s our job,” “I think it’s really important to answer those questions, because they are coming to our office as a source of good information,” “It’s a break or make deal; it effects their opinion of whether you are trustworthy or not,” “it goes a long way with the client,” “It’s the greatest way for us to establish credibility,” and “they will eventually quit coming back if you can’t help them; Google may put us out of the County Extension agent business.” A counterpoint was given by P7 who said, “It’s not so crucial to have the answer to that question off the cuff type of thing. I think they are pretty patient and understanding with me being able to give them a call back.”

When asked to assess their present ability to answer client questions directly themselves, participants gave a range of subjective percentages, reflecting different lengths of employment and/or confidence in themselves, their training and life experiences (Table 1). Horticulture was the first agricultural subject listed as the most challenging to handle by all but one of the interviewed participants (P3), who said:

> For me it would be livestock, because I’m not a “stock show jock”. I studied plants and ecology, so I’m versed in pasture management, but because of land fragmentation and need for brush control, I’ve been getting more sheep and goats questions. My next weakest subject is row crops, but farmers don’t need me; they

> have consultants and fertilizer dealers. It's the homeowners that need me, and most of the homeowner stuff, I'm pretty good with, and have the basics covered pretty well.

The synthesis of responses extracted from this research question reveals that many early-career agents agree with the "Vision Statement" of Texas A&M AgriLife Extension, which is *helping Texans better their lives* (Texas A&M AgriLife Extension Service, 2017). These particular agents appear to value assisting their clients with problems, make answering routine and diverse questions a priority, and see themselves and their office as an important resource to the communities in their counties. While they enjoyed the variety of situations and challenges that they face on the job, they also recognized that they had technical subject matter deficiencies and could not answer every question. For all but one of these participants, horticulture was the subject most described as being a challenge for them to handle adeptly on their own.

Research Question 3. What is the present extent of administrative-led and self-directed technical subject competency training?

The objective of this section of the interview was to find out what formal, agency-developed or agency-sponsored subject matter training they had received, and what steps these agents may have taken on their own to raise their technical subject competency. The eight participants represented here were on slightly different professional

development tracks, because of their respective lengths of employment and situational differences present when they were hired. AgriLife Extension typically requires new agents to undergo a “First Step” program where they work in one or more neighboring counties with an established county agent for one month to gain early insight to their job responsibilities. Two of eight participants in this study did not go through “First Step,” because of previous relevant work experience (assistant Extension agent, Vo-Ag teacher). All new agents are required participate in an organizational development program, called “New Agent Academy,” which teaches program development, implementation, and impact assessment. All but one participant in this program had completed both sessions. P9 had not been employed long enough at the time of interviews to participate in Academy 1 or 2. Technical subject matter competency is not a component of the Academy program, so formal agent training in particular subjects is directed by the agents themselves or with guidance from their district Extension director or regional program leader.

Formal events or programs that these eight agents had participated in varied. Four had attended the annual Texas Beef Cattle Short Course at least once. This is a multi-day training offered to the general public as a comprehensive beef cattle management training. Of those four, two believed it was helpful to them, and two did not. Three had attended the Texas Plant Protection Conference, an educational conference focused on agronomic and horticultural crop plant protection. They believed its concurrent session format and variety of topics offered a valuable opportunity for them to learn things they

needed help with. Four participants mentioned past participation in online/distance training events with mixed benefits. Four had participated in at least one targeted training conducted for agents at a district Extension office, on subjects such as Chronic wasting disease, Zika virus prevention, or prescribed burning for brush control. In summary, none of these agents expressed an understanding of a clear "path" for improving their technical subject matter competency. P10 provided the following perspective:

> You know there really hasn't been a lot. I did a water certification course last year (2016), I go to TCAAA (Texas County Agriculture Agents Association) conference once a year, and the few webinars that we get was about the extent of agent training that I've been involved with up to this point.

All eight participants had their own approaches to becoming more competent with technical, agricultural subjects outside of any formal class, program or conference. P1 felt that she learned new things and improved her competency by interacting and spending time with producers in her county. P2 also cited grower interaction, along with working with specialists and "personal devotion to reading about row crops." P3 devoted time to reading, both popular press and Extension fact sheets. He also felt that being a landowner helped him grow in his understanding of subjects relevant to the Extension mission. P4 described "doing a lot of reading," along with attending other county events when possible. P7 described that he viewed himself as "a student in programs that I've hosted myself in my own county." P8 believed that making herself available for

trainings, and developing programs such as a horticulture education series "help my clients, but help me too." P9 has relied on fellow county agents to help her gain competency, calling or texting them as needed, which she viewed as her own attempt at on-the-job learning and greater competency. P10 attended other county programs when possible, has taken an on-line viticulture class, monitors the eXtension.org website for information, and subscribes to agricultural magazines to stay abreast of emerging issues and news. These responses, although varied, point to a theme of *desired growth*. Early-career agents seem to recognize the diversity of subjects that they are challenged by clientele and administration to master and desire to grow in their competency of those technical subjects.

Research Question 4. What do early-career Extension agents perceive to be incentives and obstacles for technical subject matter competency training?

The agents I interviewed had difficulty articulating what they perceived as administrative-driven incentives for them to become more competent in any particular technical agricultural subject. P10 said, "There really is no incentive, other than possibly an item on a promotion packet." P9 stated, "We get encouragement from administrators to participate in things, or that something looks like a good opportunity, but I don't really know of any rewards for that, to be honest." P8 said that her only incentive was in moving up the career ladder, and that recognition was not something she otherwise needed or was motivated by. P3 said:

> Not plainly; I don't perceive a benefit or incentive to mastering a subject; we get encouragement from my DEA to be the 'go-to guy' in some certain subject. Obviously, Extension gives some performance awards, but I haven't been in this long enough to know who gets them or why they got them.

P7 explained, "I'm not sure how any of that works (i.e., promotion, awards). Right now, I'm just here to do my job." The remaining participants had similar beliefs that there were possibly promotion-based incentives for becoming more technically competent, but weren't sure exactly to what extent that could be expressed in a promotion packet.

Time was the most common perceived obstacle to growing in subject matter competency described by the Extension agents in our study. All eight participants included "time constraints" as at least one reason why they were challenged to gain technical subject matter competency. County Extension agents juggle numerous responsibilities. Some of these agents were involved with 4-H activities in their county that demanded devotion of time outside of regular office hours. Others described the time spent driving around the county or to events outside of the county (district/state meetings) as a time-related limitation that impacted their available time for competency. Distractions, another time-related factor, was described by two of eight agents who felt like they were never able to "stick with something very long" due to ongoing work-related distractions. P1 expressed frustration when she said, "I have over 500 hours of comp time, that I would like to be able to use to invest in my own self-improvement, but there doesn't seem to be a way to do this."

P10 described funding as a barrier or limitation on professional development-type training participation. Not all counties have equal funding for agent travel, and some have lower funding. When asked to participate in training events, P10 felt limited in his ability to do so, because of limited available travel funds. In this case, as is likely the case in other counties, agents sometimes face the difficult choice of either not attending some program that would help their competency or attending it at their own expense.

P8 gave an interesting perspective, explaining that the diversity of subject matter agents faced by Extension agents at the county level is of itself an obstacle. Extension agents may feel overwhelmed or uncertain of what subjects to address, and whether to focus on just one at a time. She said:

> There's just so much information out there that the public expects me to be an expert on that it's kind of a daunting task to try to be a master of it all, or even having slight knowledge of it all. It's a little nerve-racking at times.

With this obstacle in mind, administrators could assist their early-career agents by identifying training needs and goals soon after hiring to avoid this potential problem of "technical subject competency paralysis."

Research Question 5. A.) What technical agricultural subject would agents choose to devote competency training to that would in turn help them assist clients in their county? B.) What feelings were provoked from being directed to participate in a multi-class, certificate training program in horticulture?

I asked each participant to identify an agricultural subject they believed would be beneficial for them to become more competent with for Extension purposes in their present county of employment. Horticulture was chosen by four of the eight participants (P1, P2, P4, P7). Three of those four participants noted that it was home horticulture where much of their client interest and problems occurred. One participant described increasing interest in orchard crops in his county as a motivation for studying horticulture more thoroughly. P3 and P8 both chose animal science, because of the demand for livestock production information among their clients. P10 identified range management as his biggest subject need, because his county was one of the biggest cow/calf production counties in the state of Texas. All of these counties, being from the same region, have similarities in climactic conditions and their agricultural production systems, but they each have unique civic, social, and economic profiles that can alter their respective clients' interests and informational needs. Depending on the formal training and life experience of the agent in a particular county, certain subject matter competencies are more important and relevant than others.

At the time that interviews were conducted, each participant was aware of his or her selection for a pilot certificate training program in the subject of horticulture. Each had previously received the six-class schedule of topics and the training dates, which explained their requirements to travel to the training site on six different occasions from April to August 2017. I asked each participant during the interview to express their reaction and feelings about this training concept and content. Seven of eight participants conveyed positive feelings, with comments such as: “excited,” “glad they chose me,” “looking forward to it,” “happy to come,” “it gives me an opportunity to learn,” and “glad they asked me.” Three participants had ambivalent feelings, adding comments like: “I’m not overly excited about it,” “I hope I can use it,” and “I have concerns about the substance of it.” Three participants also had initially negative reactions about it, expressing thoughts like, “It’s one more thing I gotta [*sic*] do,” “Oh, man, here’s one more training to go to,” “I’m overwhelmed, and now I need to rearrange my calendar,” and “I’m concerned about what happens in my office while I’m gone.” The offering of a multi-class, in-person training satisfied a desire expressed during interviews among several of these agents for thorough, interactive training. Such trainings though require a time sacrifice that is a challenge for many early-career Extension agents.

Conclusions, Implications and Recommendations

Objective 1. Extension Agent Motivations and Perceived Incentives and Obstacles to Technical Subject Matter Competency Improvement

New County Extension agents are only partially prepared to handle the diversity of client questions and problems by their formal college educational experience. Some college degree plans better prepare students than others to be an Extension agent, depending on what county they end up working in and what the social and agricultural needs there really are. Findings in this study point to the importance of life experiences outside of college, particularly 4-H and FFA involvement and family farm exposure, as key contributors to the early-career Extension agent's success in handling diverse subject matter questions and client problems. AgriLife Extension is fortunate to be able to recruit and hire new Extension agents from a large agricultural population base where those pertinent life experiences have frequently been gained by college graduates with agricultural degrees. Hiring college graduates with agricultural family backgrounds and past 4-H/FFA involvement in essence can lessen the need for subject matter competency training by the agency. In this study, one agent who was highly involved in 4-H and FFA growing up, held several agricultural jobs in his youth, and who came from a farming family assessed his own question handling ability at 90% after only 33 months of employment in Extension.

Agent Motivation

Eight county agricultural and natural resource agents positioned in non-urban counties of the Southeast region largely expressed a strong desire to assist their clients by answering questions and providing solutions to agricultural and natural resource problems. One theme elucidated in these interviews is that early-career Extension agents have a strong desire to help clients themselves, even recognizing that their ability to provide sound information may be tied to their long-term support in the county. P3 stated, "Answering questions is our bread & butter. Answering one question may help us gain a lifetime supporter of Extension, and without us here to answer those questions, what source will people turn to?" Yet, as P8 explained, it is a "daunting task" for any agent to be highly competent in the wide variety of agricultural subjects that people seek information on. Agents who endure and continue a lengthy career in Extension gain that competency over time, but early-career agents are at risk to become overwhelmed with their need for competency and are more likely to exit the profession if the appropriate support and professional development is lacking (Ensle, 2005; Kutilek et al., 2002).

Perceived Incentives

The Extension agents I interviewed in this study relied as much on their own informal subject matter competency training as they did on formal, agency-sponsored competency training events. Their methods to master subjects included reading and literature review, site visits with growers, networking with other Extension agents in their district and developing programs for their clients that help them also. Although multiple participants

described that they were encouraged to raise their competency or excel in certain subjects by their district Extension agents or regional program leaders, they otherwise could not describe clearly how it would help their careers. Extension agencies who desire greater competency among its agents should explore how to incentivize that educational process with tangible benefits. These benefits could be travel stipends, study leave time, or agency-recognized certificates that have an established value on promotion dossiers.

Obstacles to Competency Improvement

At present, Texas County Extension agents' number one obstacle to raising competency in any agricultural subject is competing requests for their time, which can lead to burnout (Ensle, 2005). Extension administrations should always explore ways to reduce the time inputs faced by Extension agents which not only impede their ongoing self-education, but also threaten their family relationships, mental and physical health, and Extension career longevity (Ensle, 2005; Kutilek et al., 2002). One opportunity for time savings uncovered in these interviews, is to eliminate mandatory agent participation in certain state-level events, such as the Beef Cattle Short Course. Not all agents interviewed here gained competency from that particular in-person training that required their travel and time out of office. Administrators may better direct the competency growth of county Extension agents by adopting a needs-based approach that customizes an agent's career training path according to their college training, life experiences and the socio-agricultural needs of the county that they serve.

Objective 2. Current Needs for Horticulture Competency Training Among Texas County Extension Agents.

Horticulture was the subject that seven of eight early-career county Extension agents felt they were the least prepared for. The seventh agent who did not describe that same deficiency, had past life and family experiences with horticulture. The need for greater horticultural competency for many early-career Extension agents may stem from their low exposure to horticulture in high school and college, although there is no data to support or refute this theory. The need also stems from client demand, and the agents represented in this study describe ongoing or increasing demand for horticultural information in their non-urban counties. P9 described that her clients' horticulture questions were predominantly from homeowners and not horticultural producers. P4, however, stated that his horticultural questions and competency needs were for production horticulture. Horticulture is a diverse subject and these interviews support the need for broad-based horticultural training for early-career Extension agents. It is of interest to note that of the seven agents who cited horticulture as a subject matter weakness for themselves, only four stated that they would choose horticulture as a subject for an organized competency training. The two agents who chose subjects other than horticulture did so recognizing that raising their subject matter competency in other subjects would have even greater positive impact in their respective counties. The implication of this finding is that County Extension agents, even those in the early stage of their career, gain powerful insight into the informational needs of the county and

should be allowed to have input on what subjects they invest time in to become more technically competent.

3. EXTENSION HORTICULTURE IN TEXAS: PERCEPTIONS OF CLIENTELE DEMAND AND COUNTY AGENT COMPETENCY AMONG STATE EXTENSION HORTICULTURE SPECIALISTS

Introduction and Review of Literature

The development and delivery of educational materials for a particular subject matter discipline and solving of client problems within the Texas A&M AgriLife Extension Service (AgriLife Extension) is led by subject matter specialists grouped according to discipline within "units" attached to departments in the College of Agriculture at Texas A&M University. Subject matter specialists were hired by Texas' first Extension service director, Clarence Ousley, for plant pathology, animal science, dairy science, agronomy, poultry science, horticulture, and agricultural engineering (May, 2010). The specialists worked alongside the agents in demonstration efforts to encourage planting of new crops or encourage adoption of new techniques. For example, "In 1916, the county agent of Henderson County, Texas, and the specialist in horticulture of the Extension staff at the agricultural college put on a series of demonstrations throughout the county in pruning and spraying peach orchards" (Knapp, 1920). The agency's client service strategy continues to be for county Extension agents to be the first point of contact for assistance with problems or education at the local level, and for subject matter specialists to assist agents across the 254 counties in Texas to solve problems and answer questions that exceed agents' familiarity, experience or competency. This two-pronged, cooperative

strategy extends to general education with agents and specialists working individually, jointly and in teams to educate clientele throughout the state with an array of educational tools, including face-to-face and distance-taught one-to-many educational programs, written and digital publications, e-learning modules, videos, mass media communications and websites.

The subject matter "units" within AgriLife Extension presently include: agricultural and environmental safety, agricultural economics, organizational development, animal science, biological and agricultural engineering, ecosystem science and management, entomology, family and community health, horticulture, infectious animal diseases, nutrition and food science, plant pathology and microbiology, poultry science, recreation, parks and tourism, soil and crop sciences, the Texas Water Resources Institute, wildlife and fisheries sciences, and 4-H. Extension professionals in these units hold the job title of of "Extension Specialist" or "Extension Program Specialist," and are located strategically in the state according to administration-determined resources and the perceived needs of external clientele.

The number of subject matter Extension specialists in Texas is small, ranging from three to twenty-three across the eighteen different unit/departments described above. For a state as large and populous as Texas, it is therefore beneficial for County Agriculture and Natural Resource Extension agents, who are present in 250 of the 254 counties, to have some competency across agricultural subject areas in order to assist clients expediently.

It is also beneficial for subject matter specialists to multiply their capabilities through County Extension agent subject matter training.

Horticulture is an important agricultural subject in Texas given the population growth and importance of gardening as a recreational pastime in the United States (Brashier et al., 2006). According to the U.S. Census Bureau, Texas had the highest population increase in the country from July 2018 to July 2019, adding an estimated 367,215 people ("State Population totals: 2010-2019," 2019). New home construction in Texas was also the highest in the U.S. in 2019, accounting for 14.86% of the national total ("Building Permits Survey," 2019). A survey of seven states demonstrated that landscapes that improve their aesthetic contribution from “average” to “excellent” increase home values ten to twelve percent (Niemiera, 2016), therefore it can be expected that population growth areas will experience concomitant increase in demand for horticultural information and problem solving.

Horticulture is important in Texas beyond home beautification and gardening. The total annual economic contribution of the “green industry” in Texas, canvassing nursery and greenhouse production, florists, landscape architectural services, lawn and garden equipment and supplies, etc. was estimated at $19.5 Billion dollars in 2018 (Palma & Hall, 2019), an increase of $700K per year compared to 2015 (Palma & Hall, 2016). Horticultural crop production industries, including fruit and vegetables are also important. The 2017 USDA Census of Agriculture reported that Texas held 176,837

acres in orchard production and 97,648 acres in vegetable production, ranking 5th and 13th in the nation, respectively ("Census of Agriculture State-Level Data," 2017). Commercial horticulture industries are important clientele to Extension, and in Texas they are supported by both County Extension agents and Extension specialists.

Texas A&M AgriLife Extension provisioned twenty-four of the more populous counties in the state with a county Extension horticulture agent (CEA-HORT), most of whom hold a master's degree in horticulture or closely aligned plant science degree. Horticulture agents were hired to bring greater competency to horticultural education and problem solving at the county level, but their responsibility is to a single county. The remaining 226 counties must address horticulture education and problem solving with a County Extension agent for agriculture and natural resources (CEA-ANR) agent who may have limited or no formal training in horticultural science and less ability to satisfy client needs independently of subject matter specialists. The current state agency funding climate, which limits staffing of state Extension horticulture specialists and county horticulture agents in Texas despite a growing population base and commercial horticulture industry, calls for an assessment of the current level of CEA-ANR competency and need for subject matter professional development.

Theoretical Framework

The Service-Satisfaction Model for Extension described by Terry and Israel (2004) is used as a guiding framework for this research study. The model establishes the relationship of agent performance to end-user (Extension client) satisfaction. The perceived service relevance and accuracy is key to favorable client satisfaction outcomes. Agent performance and experience were shown to influence client perceptions of service relevance and experience. The service-satisfaction model is influenced by the Service-Profit Chain (Heskett et al., 1994), a model for corporate business success that establishes a relationship between employee loyalty and customer satisfaction. Employee loyalty is manifested in high quality customer service, which in turn raises customer satisfaction, customer loyalty and profitability (Heskett et al., 1997). In the Service Profit Chain, companies foster employee loyalty through "internal service quality" inputs of employee development and recognition, among other things. Cooperative Extension similarly may strengthen employee (agent) retention (loyalty) and ultimately customer satisfaction through a process of identifying professional development needs.

Purpose and Objectives

The purpose of our study was to evaluate organizational preparedness and effectiveness for delivering Extension education and problem solving in horticulture in the state of Texas, through a qualitative assessment of the experiences, perceptions and intentions of Extension subject matter specialists. The Extension Horticulture Unit housed within the AgriLife Extension is currently staffed with 23 specialists engaged in diverse aspects of education and outreach in horticulture, such as viticulture, vegetable production, and youth gardening. I interviewed each study participant individually to accomplish the following objectives.

1) Elucidate the potential impacts of Extension horticulture in Texas.

2) Assess past, current, and future client demand for horticulture education and outreach in Texas.

3) Determine county Extension agent competency in horticulture and the merits of attempting to raise agent competency.

4) Identify county agent training strategies and obstacles to implementing those training strategies.

My desired research outcome was to synthesize a current status and future vision of horticultural education and outreach in Texas from those Extension professionals who are the most knowledgeable and engaged in the discipline/field of study.

Methods and Procedures

I made a purposive sample of nineteen Extension specialists and Extension program specialists employed in the Extension Horticulture Unit with AgriLife Extension from the existing population of twenty-three full-time specialists. The balance of four specialists/program specialists not included in the study were omitted because one was myself, one declined to participate, and two were hired as support personnel for a program specialist included in the sample of nineteen. I presented a slate of 33 questions to each participant either in-person or by distance technology (Zoom US) in a semi-structured style that allowed for naturalistic inquiry and discussion of salient points beyond the structured questions. The participants varied in gender, their length of service with AgriLife Extension, total work experience in the field of horticulture, educational background, staffing location in Texas, and their area of horticultural specialization (Table 2). Interviews took approximately 50 minutes, and were transcribed and coded, in order to thickly describe the themes contained in their responses.

Table 2. Extension Horticulture Subject Matter Specialist Demographics; N=19

Job Title	Area of Horticultural Specialization:	Staffing Location (City in Texas):	Gender	Education	Length of Current Employment:	Length of all employment in horticulture, including current position:
Extension Specialist (Asst, Assoc or Full Professor[1]: 10 Extension Program Specialist: 9	Viticulture & Enology: 8 Vegetable: 3 Fruit & Nut: 3 Ornamental & Landscape: 2 Master Gardener Program: 1 Youth Gardening: 1 Economics & Marketing: 1	College Station: 7 Lubbock: 3 Fredericksburg: 3 Dallas: 1 Denton: 1 Hallettsville: 1 Overton: 1 Uvalde: 1 Weslaco: 1	Male: 13 Female: 6	BS: 1 MS: 8 PhD: 10	< 3.0 yrs: 4 3.1-5.0: 3 5.1-10.0: 3 10.1-15.0: 3 15.1-20.0: 3 20.1-25.0: 1 30.1-35.0: 2	<3.0 yrs: 1 3.1-5.0: 3 5.1-10.0: 1 10.1-15.0: 2 15.1-20.0: 1 20.1-25.0: 3 30.1-35.0: 2 35.1-40.0: 3 50.1-55.0: 1

[1] *Note:* AgriLife Extension specialists are also non-tenure track faculty in the department to which their Extension unit is attached. They are promoted by departmental faculty committees from assistant professor to associate professor to professor.

Credibility of this study was built upon the following 1) IRB-sanctioned informed consent process that clearly allowed participants to not participate if they did not wish to; 2) conducting the interviews either in person in their office or by distance technology from each person's office, allowing interviewees to be in their most familiar/comfortable work setting during the interview; 3) The interviewer, who was a fellow employee in the Extension Horticulture Unit of AgriLife Extension, approached the interviews from a "co-worker's perspective" with a conversational, yet confidential approach to the questioning; and 4) The recording process likewise was not intrusive, with each participant familiar with the Zoom US software and its integrated recording tools. Triangulation of this research study was gained by having more than one researcher

review and analyze the data. I provided peer debriefing memos to Dr. Shackelford, the lead researcher from an audit trail.

The study results are most transferable to other Extension subject matter units within AgriLife Extension but should be transferable to other Cooperative Extension systems where external client service can be improved through professional development and continuing education. Transferability to other state Extension systems is aided by the diversity in work experiences, background and training of the nineteen individuals that were studied. For those other states that face growing demands for information in the area of horticulture, the findings from this study have merit for increasing and improving customer satisfaction, as well as political and financial support.

Findings

Research Question 1. How do AgriLife Extension Horticulture Specialists Believe Their Outreach Programs Contribute to the Agency Vision Statement, "Help Texans Better Their Lives"?

The Extension professionals in our study manifested great diversity of subspecialties within the field of horticulture in the response themes to our first research question. Horticulture has many ways to improve the lives of citizens in a state like Texas, and Extension specialists working in the subject area recognized the connection between

garden plants and improving human lives. I obtained sixty-three responses from nineteen participants and categorized them into eight themes (Table 3).

Table 3. Perceived Contribution of Extension Horticulture to the Mission of Texas A&M AgriLife Extension

Theme	Frequency
Horticultural Education & Problem Solving	14
Leadership Role	12
Financial Impact	9
Physical Wellbeing	9
Emotional Wellbeing	6
Beautification	6
Social Benefits	6
Environmental Stewardship	1

Fourteen of the 19 participants provided statements that coalesced around a theme of "Horticultural education and problem solving, highlighting the core responsibility of interpreting the science of garden culture to a diverse clientele. "Leadership role" was my interpretation of responses given by twelve specialists, reflecting their belief in serving as a liaison to the public (consumers of horticultural products) or as an intermediary between academia and producers. The words "knowledge," "understand," and "awareness" reoccurred in those participant's responses. I also perceived this leadership role to be an important assistance to producers of horticultural crops by not only making consumers aware of what is produced locally around them (P18), but how it is produced. P2 said:

> We are exposing the general public to the process of growing plants and what kinds of care and effort it takes to go from a seed to a super market …..It's not

> just to help educate growers on how to improve better what they're currently doing, I think it's also to stay on the pulse that agriculture is important; particularly on the discussions that organic is feasible or not, or GMO is safe. It's our role to be that person, where we work in this world, and we can sort of walk between them.

Nine participants identified "Financial impact" on the commercial horticulture industry as an important contribution to the agency mission, through working directly with producers (P4), identifying and aiding new crop industries (P15), sustaining jobs and families (P1), and enterprise stability (P19). The theme "Physical well-being" (9 of 19 responses) through diet enrichment from increased access and availability of fruits and vegetables and "physical involvement with a hobby" (P14) was also a common response among participants. "Emotional wellbeing" (6 responses) is a less commonly-considered positive contribution of horticulture to peoples' lives that was elucidated in this study. "Plants make people happy" was a conclusion I drew from several participant's responses. P5 said, "I think it helps ground people. It's very grounding. It's very peaceful, grounding and therapeutic, besides providing food and beauty." P19 pointed out the importance of teaching people how to grow plants successfully with this statement, "we have such a wonderful message to present to people, and what I found is that if we can help people be successful (with plants), they are going to be very happy in that." Closely connected to emotional wellbeing was "Beautification" (6 responses), the improved quality of life that comes from beautification of indoor and outdoor spaces and growing plants for ornamental and aesthetic value. The theme of "Social benefits" (6

responses) captured remarks like “keeping rural land in agriculture” (P18), “expanding opportunities and activities for master gardener volunteers” (P6), and “bringing the college education experience to people who didn’t have that opportunity when they were young” (P11). Although it was not a popular response among these specialist participants, the theme of “Environmental stewardship,” popular in some demographics today, was mentioned by P7, who said, “We promote and educate people on practices that allow them to grow healthy food products as well as implementing pest management strategies and sustainable strategies that are beneficial to the environment.”

Research Question 2. Change in Clientele Demand for Horticultural Expertise and Support (Evidence, Reasons and Prediction for the Future).

I asked study participants to describe whether client demand for their Extension horticulture expertise was greater than, equal to, or less than when they started in their current Extension specialist position and what evidence supported their respective positions. I then asked them to comment on what they believe influenced the change (or lack thereof), and what they anticipate the demand would be like ten years in the future. Fourteen of nineteen participants said that client demand for their time, attention and expertise had increased (Table 4). Four claimed no difference and one participant felt like demand had decreased.

Extension horticulture specialists that perceived an increasing demand for their expertise supported that position with a variety of indicators, including increased email traffic, phone calls, site visit requests, speaking invitations and client participation in programs (P8, P13). Beyond quantitative indicators, some specialists had observed a change in the types of questions asked and the type of support requested, indicating industries that were maturing, facing more complex questions and needing more sophisticated help. P15 provided this comment,

> Every year we see more and more acres planted, and we also see more people coming to join the industry, so I get a lot of phone calls, emails from growers asking somewhat complex questions—growing questions. But for my position, I'm having growers wanting me to start research projects, and they have financed some of those themselves. So I take that as a sign that they need my expertise.

Twenty-one reasons were given by fourteen participants to explain the perceived increase in client demand, and seven thematic categories emerged (Table 4). "Program awareness and success" (7 responses) and "Commercial industry trends" (7 responses) were the top two elucidated themes. The program awareness and success theme reflected a belief among several participants that their own educational program success (P1), visibility through web presence (P17) and diversity of programs offered by the unit (P8) was connecting favorably with a dynamic clientele in Texas. Part of the success of those programs included overcoming plant production challenges. "I think our problem solving on the number one limiting factor for growing grapes in Texas (Pierce's Disease)

has directly led to the growth of the commercial wine industry in Central Texas" (P9). The growing winegrape industry in turn led to an increase in the number of Extension specialists hired to support it, and then the outreach efforts of those new positions were were stimulating client demand and interaction. P14 stated, "I'm becoming more established in my region, so people are more aware that Extension is available to help them in viticulture." The commercial industry trends theme was built entirely from responses of participants engaged in viticulture and enology. These Extension specialists perceived from their experiences a rapidly growing and "trendy" winegrape industry in Texas, spurred by population growth, agrotourism (P2, P9) and belief among traditional row crops farmers that winegrapes could be a high value crop that required less irrigation (P15).

Table 4. Extension Horticulture Specialists' Perceived Change and Reasons for Change in Client Demand for Horticultural Expertise

Client Demand	Frequency	Reasons cited for change	Frequency
Increased	14	Program awareness and success	7
		Commercial industry trends	7
		Information and assistance	5
		Socioeconomic change	4
		Horticultural opportunities	2
		Program participation increase	2
		State legislative influence	1
Equal	4	New employee; short comparison time	1
		Popular and stable specialization area (vegetables)	3
Decreased	1	Competitive and inaccurate mass media information	1
		Unwillingness to attend programs in person; smartphone preference	1

Other themes found among this "increased demand" subset of participants included: "Information and assistance" (P3, P5, P12, P13, P14), "Socioeconomic change" (P3, P6, P7, P17), "Horticulture opportunities" (P2, P9) stemming from population growth, "Program participation increase" (P8, P13) and "State legislative influence" (P4).

Those specialists who believed their client demand was the same as it had been in the beginning were either relatively new hires who had not perceived much change since their hiring date, or believed their area of horticultural experience was perpetually popular and stable with regards to client demand. Three of the four participants in this subgroup worked primarily in the area of vegetable production. P10 described a consistent client demand by saying,

> Vegetable gardening in general, vegetable production in general is always a hot topic as a hobby by homeowners, so that group, the master gardeners, the landowners, the hobbyists, that's hot! Commercial growers, only when they have trouble; they remember you and come to you, so let's call that the same.

P11 echoed the sentiment, stating, "My plate has always been full, and I've never had time to take anything off of it." P16 described consistent or equal demand over time happening through a shift in clientele demographics. "When I first arrived, there was a large demand for information for large commercial farms there, and that has actually decreased in my area. Small acreage farms, the need for the information that I deal with, has actually increased" (P16).

Only one specialist believed that external client demand for a horticultural specialist had declined. That participant's perception stemmed from observing a reduction in client participation in traditional face-to-face Extension educational programs "over the last six years or so" (P19). P19 felt that Extension was losing clientele participation and demand particularly in the metro areas of Texas, due to competing and "frequently inaccurate mass media information," and a growing preference for "obtaining information online with smartphones."

The perceptions of future demand for Extension expertise in horticulture in this study suggest at least a continued, if not greater, need in ten years. While three participants were uncertain and declined to take a position, none predicted a decreasing demand for specialists in Extension horticulture. The responses of eight specialists could be themed as "Status Quo," or believing that future demand will be similar to the current level. Explanations for this thinking included: "the need for information is acute and will remain acute" (P3), "grapes will continue to be difficult to grow" (P2), "the middle to older age group of people that are predominantly interested in vegetable gardening is constantly being replaced" (P10), and "the need (for help with challenges) isn't going away" (P12).

Another eight participants' responses could be themed "Enthusiastic," believing that client demand will be greater in ten years. Statements contributing to this theme included: "We are beginning to attract a younger population" (P8); "The wine and grape

industry in Texas is still very young and there is lots of room for growth. Based on how much wine we produce and sell, in looking at the market share, it's still very small" (P14); For schools, there is a lot of demand for certificate programs or programs that can provide career exploration for kids, to think about potential career pathways, so that is going to be an area that continues to grow" (P13); and

> I see more interest in DIY stuff, more interest in doing things themselves, more landscape design, irrigation, and propagation. I also see sustained and continued increase interest toward environmental stewardship as time goes on, but also in home-level production of food commodities (P6).

Research Question 3. County Extension Agent Competency in Horticulture.

I asked our participating Extension specialists to estimate the number of different county agents (all types) they interact with in a year with interaction defined as a one-to-one interaction at a client site visit, phone conversation, email exchange, one-to-many interactions in an educational presentation with county agents in attendance, or through receipt of a newsletter. The Extension specialists in this study epitomize "Specialist," with some having very narrow areas of focus in the field of horticulture, including viticulture (for wine production), enology, and ornamental nursery economics. From such narrow specialization and in some cases staffing location, some of these participants had no to very little (<10 agents per year) professional interaction with

county agents annually. Others, while similarly having a very narrow focus, like youth gardening or master gardener volunteer coordination, had a high level of annual county agent engagement (75-100 agents), because those particular programs were popular with external clientele.

Seventeen specialists I interviewed had at least one interaction with a county agent each year. I then asked them to select one of three categorical responses to a question about how similar or different their agent interaction was from year to year. The available responses were: a) mostly the same agents or same counties each year, b) it's very random; always interacting with different agents, or c) some of the same agents and counties, but some different counties show up each year too. Six of the seventeen specialists agreed that their county agent interaction was largely with the same agents/counties year in and year out. Eleven perceived that their county agent interaction had consistency with whom they worked each year but was not completely static. The absence of any specialist choosing "choice b," a very random annual agent interaction provided a supportive case for the familiarity that these Extension professionals have with their county agent counterparts and ability to comment on their competency in the subject of horticulture.

I asked specialists to provide summary statements or descriptors about the competency in the subject of general horticulture of county Extension agents with whom they work as a class. Very few of these specialists had any interaction with 4-H or Family and

Consumer Health agents, so only CEA-ANR and HORT agents were considered. For ANR agents, four descriptor categories emerged from the responses (Table 5). I summarized the best/highest opinion category with the word “satisfactory”; given by only one specialist (Table 7). P2 described ANR agents’ competency as “decent and motivated to investigate”. “Mediocre” summarized two participant descriptions who responded with the words “variable, somewhat to slight,” (P8) and “fair at best” (P12). separated the remaining responses into “low” competency (43.75%) and “very low” competency (37.5%). I derived the low category from interviewee words “low,” “basic”, and “limited”, while the very low group was derived “very little”, “poor”, “pretty low” and “very low”.

Table 5. Texas County Extension Agent Competency in Horticulture, as Perceived by State Subject Matter Specialists

Perceived Level of Competency	CEA-ANR Frequency (n=16)	CEA-HORT Frequency (n=18)
Excellent	0	8
Good	0	4
Satisfactory/Adequate	1	5
Mediocre	2	1
Low	7	0
Very Low	6	0

CEA-HORT agents were considered very differently regarding their competency in general horticulture by the specialists in Texas that they work with, which was to be expected at some level (Table 5). I placed responses from 18 participant questions into four categories, with the lowest opinion category being “Mediocre,” described by P10 as

"moderate, room for improvement." "Adequate" described the responses of five participants who used words like "fair," "pretty good," and "fine" (P6, P7, P16, P17, P19). "Good" competency reflected the opinions of four participants, who used the words "really good" and "very well" (P11, P12, P13, P18). The highest opinion category, formed from eight participant responses is described as "excellent," based upon words and phrases like "very competent," "strong," "very good," "extremely knowledgeable," "high" and "very high" (P2, P3, P4, P5, P8, P9, P14, P15).

Research Question 4. Agency Benefit From Agent Training.

I asked the Extension horticulture specialists participating in our study to give an opinion on whether agency-led training in the subject of general horticulture would be beneficial to the mission and work of AgriLife Extension (Table 6). Regarding ANR agents, only one participant was "negative" about a potential benefit, believing that forcing training on agents could result in those agents being overconfident and less motivated to obtain appropriate assistance from specialists, ultimately resulting in client dissatisfaction. Two participants agreed conditionally to a benefit, those conditions being if the agent's county of responsibility was one where "there are a lot of horticultural crops grown" (P7) and "if there's an interest that's driven by their clientele or themselves" (P11). P11 elaborated further, "If they have a clientele that's not driving them, do they retain it? Probably not, because they don't practice it." The remaining participants perceived a potential agency benefit to training ANR agents, but were divided into two groups,

called “Favorable” (5 participants), which captured those responses that were simply “yes” (P2, P6, P12, P15, P16) and “Emphatic” (10 participants), that was composed from responses that frequently included the word “absolutely” (P1, P3, P4, P9, P10, P13, P14, P17, P18, P19). Ten participants across the conditional, favorable and emphatic subgroups provided an explanation of why the agency would benefit from ANR agents receiving competency training in horticulture. I found four themes in their responses, including: “customer satisfaction and respect” (P7, P10, P11, P12, P13, P14), “preparedness for emerging topics in horticulture” (P4, P14), “general educational value” (P1, P5), and “expanded specialist programmatic reach” (P19) (Table 7).

Table 6. Subject Matter Specialist’s Perceived Benefit of Training Two Types of County Extension Agents in Texas; N=19

Perspective	CEA-ANR Frequency	CEA-HORT Frequency
Negative	1	0
Conditional	2	0
Favorable	5	19
Emphatic	10	0

Table 7. Justifications Given by Subject Matter Specialists for Training Two Types of County Extension Agents in Texas

CEA-ANR	Frequency (n=11)	CEA-HORT	Frequency (n=14)
Customer satisfaction and respect	6	Agent benefit	8
Emerging topics preparedness	2	Agency public perception	4
Expanded specialist programmatic reach	1	Specialist benefit	3
General educational value	2	Client benefit	2
		Unit Benefit	2

Despite having a generally favorable opinion of the subject matter competency of CEA-HORT agents (94.4%=adequate, good or excellent), all nineteen specialists believed that agency-led training would be beneficial for this group of gents (Table 8). I compared and segregated nineteen responses of fourteen participants into five benefit themes (Table 9). Eight specialists believed in an "agent benefit" (8 participants) even though CEA-HORT agents already work in and have some competency in horticulture. "Expanding their areas of horticultural expertise" was the second most common justification given (P4, P7, P9, P14, P19). "Agency public perception" (4 participants) reflected the idea that Cooperative Extension benefits broadly from more people having expertise as industries or new horticulture trends grow and invariably find their way to local points of contact in the agency. P2 explained, "I think it helps for everyone to have that air of expertise instead of just saying 'well I don't know, go talk to this person'." I used the theme "Specialist Benefit" to summarize feelings among three participants that subject matter specialists themselves ultimately benefit from training horticulture agents through reduced teaching load (P10), multiplied effort (P12), and greater ability to devote to other resources (increased efficiency) (P6). The theme "client benefit" summarized those responses expressing the benefit to external clients of faster and more direct access to assistance. P17 described it by saying, "It streamlines the communication for them to deliver the information to their clientele, rather than delay by them serving as the intermediary, especially for those straightforward or simple questions." The final theme I found was "unit benefit", obtained from two responses that indicated Extension Horticulture as a departmental group, would benefit from having more time to devote to

research and resource development (P6), and from unification of opinions on technical content.

> We should do trainings to bring people together, so they are on the same page about horticultural questions and answers. I've seen one HORT agent give this answer for this problem and have a different HORT agent give a different answer for the same problem. I'm not saying one is wrong and one is right; maybe they're both right, but that can lead to some confusion, and I think we can discuss that in that training (P11).

Research Question 5. County Agent Training Vision, Elements and Obstacles.

The nineteen Extension specialists participating in this study were well qualified to envision an agency-led competency training for county Extension agents in the subject of horticulture. They held 19 bachelors, 18 masters and 10 doctoral college degrees among them, and accumulated approximately 422 years of work experience in the field of horticulture. I asked them to estimate the hours they believed were needed to raise the competency of early-career ANR agents who had no college training or formal work experience to a functional level of competency that would reduce their dependency on specialist assistance and improve their customer service capabilities. The range in their responses was 122 hours, with a mean of 45.4 and std. deviation of 36.8, indicating a wide variety of opinions. The "Minimalist Group" (7 specialists) advocated for concise (1, 2 or 3-day) programs, focused on common questions and problems that ANR agents

throughout the state routinely encounter (P5, P9, P14, P15, P17, P18, P19). P18 presented a common sentiment for this subgroup's theme, "I think a minimum of twenty-four (hours). That's a minimum needed to cover basic horticulture principles and give them examples of common horticultural questions." Other components included in this format were "interacting with and getting to know the specialist/trainers" (P19), hands-on demonstrations, and "time going out into the field with a specialist to gain experience" (P5).

I placed seven specialists in the "Moderate Group," who requested program lengths of 40-50 hours (P2, P4, P6, P8, P10, P13, P16), with a mix of classroom training and field trips (P16). They felt the longer format (5+ days) provided more time for experiential learning. P10 suggested, "You want to have calculations, calibrate a sprayer, do the math yourself, show me the answer, not just sit and listen. In five days, I think they can feel comfortable that they have a strong foundation." Similarly, P4 believed that a full week (5 days) was important as a learner commitment, stating "It (40 hours) gets you out of your comfort zone, and so if you devote a week, then you're there and you're engaged." Some of the moderates included a request for follow-up and refresher courses (P8, P13). P8 said, "You almost need some refreshers where you come back and hear it again with a different speaker or a different topic. It's not just a once and done."

The "Intensive Group" included three specialists (P3 P7, P12) who perceived need for a more in-depth training of from two to three weeks to provide the depth of knowledge

that a county agent needs to be more effective at providing client assistance for problems that are not among the most common. P7 believed that the three weeks should be dispensed as annual, five-day trainings for three years, stating, “And that’s pretty minimal, honestly. Another 10 hours of self-paced, E-learning to do on their own would help too.”

P11’s approach fit none of the other three categories, describing a four-session training, spread over two years, with each session lasting one day.

> I don’t believe we can train a person in a day or two days. I think it should be spread over a period of time, whether it’s once every six months, once quarterly, three or four times. Long trainings where people are sitting down more than four hours is too long; you’re losing their ability to store that, so an ideal training for me would be somewhere where you’re indoors talking about the basics for a max of three to four hours, and then going to the field to visualize some hands on demonstrations. Come back in three months or six months and do a different subject and quiz them about past subjects, their past experiences; let them have some input into their training—maybe having at least a discussion of what they’re facing.

I asked the specialists participating in the study to describe what obstacles or limitations they perceived to implementing the horticultural competency training for agents that they had envisioned. I then sorted forty-four responses obtained from all nineteen

participants into seven thematic groups. “Financial” (8 responses) and “Logistics” (8 responses) were the two-most common obstacles identified by participants. The specific financial limitations centered around travel expenses for both trainers and trainees. Logistics included: scheduling through conflicting events for trainers and trainees, training materials developed beforehand, adequate space, and a central location for trainees dispersed over a wide geographic area. “Trainee Workload” (7 responses) and “Trainee Motivation” (7 responses were the next most common obstacle themes. County ANR agents are known to work long hours, juggle many different committee meetings and programs, making it difficult to stop for professional development. P8 felt that this obstacle was important, stating:

> Their limitation is their job is still forty hours, whereas we have administration saying block off this time for training skills and such. And maybe even to the point where you don’t have to do this and this and this. That’s the only way (this can be done).

Equally important to this group of specialists was whether the agents themselves would desire to learn something about horticulture. “Just their willingness to learn. Some of them would just rather pass off questions to specialists” (P16). P19 was emphatic in saying, “Please don't make it mandatory! I’d rather have five people that want to be there than fifty that are forced.” A remark by P15 points further to what specialists perceive as essential with trainee participation; that they are helped to see the importance of gaining competency in the subject. “You have to convince them that this is important.” Six

specialists described “Trainer Workload” as an important obstacle. “Everybody is busy”, said P4. “Time, of course” (P17). Everything in the program has got to be developed, so time is correct” (P12). “Time—absolutely for me” (P1). I used “Administrative Support” as a theme to describe four specialist responses. The specific administrative actions those specialists desired were “time commitment for trainees” (P14), reducing the agent reporting obligation to increase available training time (P10), selecting the right agents to be involved (P19), and elevating specialist/trainer engagement as a priority (P9). The final theme revealed in participant responses was “Learning eEnvironment” (4 responses). Horticulture lends itself to experiential learning, and four specialists pointed to the need for making agent training interactive, “hands-on” and with real world examples (P2, P6, P13, P18). P13 clarified by saying:

> I love online stuff, and there is some professional development that can happen that way, but I also think for some of our subject areas, having the hands-on opportunity to actually do it. If we are showing them how to do a raised bed, they need to have the hammer and nails and run the skill saw to be able to do it—experiential learning.

Conclusions, Implications, and Recommendations

Objective 1. Elucidate the Potential Impacts of Extension Horticulture in Texas.

The familiarity of nineteen Extension horticulture specialists with the subject of horticulture and their ability as Extension professionals to interpret educational programs revealed important impact themes that should help AgriLife Extension justify level or increased state funding. Horticulture has the capacity to very directly improve the lives of Texans in a variety ways by teaching people how to grow plants for food production and beautification of indoor and outdoor spaces that will provide opportunities for financial sustainability and contribute to physical and emotional wellbeing, while also positively impacting the environment. Some Extension specialists perceive themselves as holding an important role beyond direct client support; to also act as an educating liaison to the public, bringing awareness of the availability and benefits of horticultural crops and industries in Texas.

Objective 2. Assess Past, Current, and Future Client Demand for Horticulture Education and Outreach in Texas.

The theoretical growth in demand for horticultural information and problem solving believed to accompany the rapid pace of population growth in Texas is consistent with the perceptions of external client demand for their expertise by specialists in the

Extension Horticulture Unit. Eighteen of nineteen specialists interviewed believed the demand for information and problem solving was either as strong as (equal) or greater than when they started in their respective positions of employment. Of those who perceived increased demand, the themes elucidated from their explanations for the increase point toward continued increase, such as growing program awareness, a real need for assistance with problems and even legislative influence. Consistent with these indicators, was the prediction made by sixteen specialists that the level of client demand for horticultural expertise and assistance would either be the same or greater in Texas in ten years.

Objective 3. Obtain a Consensus on County Extension Agent Competency in Horticulture and the Merits of Attempting to Raise Agent Competency.

Extension specialists working in horticulture generally had a low opinion of ANR agent competency in the subject of horticulture, with a few exceptions. Conversely, their opinions on the competency of the twenty-five CEA-HORT agents in the state was mediocre or higher, with twelves specialists describing it as good to excellent. They perceived benefits to providing subject matter competency training in horticulture to both groups of agents to increase customer satisfaction, raise the public perception of the agency and provide benefits directly to the agents themselves, to the specialists, and to the Extension Horticulture Unit.

Objective 4. **Identify County Agent Training Strategies and Implementation Obstacles.**

The perception of the hours needed to raise ANR agent training to a functional level of competency varied among this group of Extension specialists. One to three days of classroom teaching augmented by experiential learning methods was ample in the minds of some specialists. Others believed building a more capable level of competency among ANR agents with little background or familiarity with horticulture required one week or more of instruction. The perceived obstacles to training agents started with "financial" and "logistical", which would both become more acute in an effort aimed at training large numbers of agents in moderate to intensive durations. Considering that specialists viewed trainee motivation as an important obstacle, and that the "conditional" group of specialists believed that ANR agents benefit from training if they are in a county where the horticulture production or client demand for horticultural information is strong, AgriLife Extension should consider developing a county scoring method for horticulture demand, and use that scoring to prioritize CEA-ANR training.

AgriLife Extension has an asset in its small population of county horticulture agents who serve 20 of the top 25 most populated counties in Texas, as well as four counties with concentrated horticultural demand. To date, Extension leadership has not moved them into multi-county roles as has been done in other states, either as multi-county staff agents (Rockwell et al., 1993), or in cluster teams (Hutchins, 1992). Mobilizing of field

agents across county boundaries has encountered both pros (Hutchins, 1992; Rockwell et al., 1993) and cons (Bartholomew & Smith, 1990) in other states. Success of such staffing plans depend on a combination of socio-economic factors, geography, and the dynamics of county commissioners' courts, who may exert resistance to sharing personnel they are funding with neighboring counties (Campbell, 1968).

Extension specialists participating in this study had generally high regard for CEA-HORT capabilities and competency. Yet they also perceived important merit in providing subject matter professional development to this group of agents for the purpose of improving the consistency in their approach to complex horticultural questions and problems. Increased investment in CEA-HORT training, along with a measured approach to CEA-ANR training in "high horticulture" counties could be an effective strategy for preventing Extension from lagging in its ability to provide client support in this popular subject area.

4. ASSESSMENT OF THE REGIONAL, TENURE-ASSOCIATED, AND EXPERIENTIAL INFLUENCES ON HORTICULTURAL COMPETENCY AND RESOURCE UTILIZATION OF TEXAS COUNTY AGRICULTURE AND NATURAL RESOURCE EXTENSION AGENTS

Introduction and Review of Literature

One of the recognized problems facing Extension nationally is employee turnover from voluntary separation (Extension Committee on Organization and Policy, 2005). The job of a County Extension agent is demanding from the standpoints of time commitment, interaction with diverse adult audiences and youth groups, local committee involvement, reporting and accountability, and travel requirement. Brodeur et al. (2011) pointed to job satisfaction as being central to the problem of Extension employee turnover, and that not believing in one's own ability to do the job well (*to be competent*) is central to job satisfaction.

County agents are at the forefront of Extension clientele interaction (Bailey et al., 2014), and have the responsibility of satisfying that clientele with their own subject matter expertise (competency) or identifying and delivering resources that will competently help and satisfy that clientele. Extension clients, in the agriculture sector alone, have very diverse needs for information and assistance, from livestock production, to rangeland improvement, row crop production, wildlife management, horticulture and

many others. Competency in all of these subjects can be difficult for an Extension agent to achieve and maintain.

Horticulture is an example of just one agricultural subject that a County Extension agent may or may not have gained competency in prior to employment as an agent. The Texas A&M AgriLife Extension Service (AgriLife Extension) has twenty-four counties in the state with a dedicated county extension horticulture agent (CEA-HORT), most of whom hold master's degrees in horticulture or closely-aligned plant science degrees. The remaining 226 counties must address horticulture education and problem solving with a County Extension agent for agriculture and natural resources agent (CEA-ANR) who is a generalist, and as such must attempt to be competent n horticulture along with all other subject areas. Due to what we perceived to be a growing demand for horticulture expertise in Texas and an agency funding climate that limits staffing of personnel for horticulture, we felt it was timely to survey ANR agents across Texas to better understand the demand for horticulture in the state, as well as agent receptivity and desire for competency training in the subject.

Theoretical Framework

Harter's Competence Motivation Theory (1978) provides a theoretical framework for our County Extension agent survey. Harter's theory, originally labeled "Effectance Motivation Theory", was a modification of the Effectance Motivation Theory (White,

1959) that was formed around the concept that "organisms" (people) have an inherent desire to cope with their environment in an effective way that results in feelings of efficacy. Harter affirmed that "effectance" and "competence" describe the same construct and provided a framework for modeling child development outcomes to be either intrinsically or extrinsically-motivated toward competence and achievement in life. Harter posited that individuals exposed to early, positive reinforcement (attention, praise, rewards, etc.) for not only mastering tasks or concepts, but for doing so independently, continue through life to have internally defined goals for competence that need minimal and occasional outside reinforcement. Individuals exposed to deficient amounts of positive feedback or even excess amounts of negative feedback for their developmental competence will continue to require more external motivations and approval toward competency (Harter, 1978).

Harter (1978) conceptually and operationally defined the construct "self-esteem" as "perceived competence" and defined three competence domains important to people as cognitive competence, social competence, and physical competence. Although Harter's Effectence/Competence Motivation Theory focused on the formative competence motivation development factors in children, the contributions and importance of competence motivation beyond childhood is emphasized by Elliot and Dweck (2005) who state that competence motivation is "ubiquitous in daily life", and an important influence on emotional wellbeing anywhere competence evaluation may happen, either personally, socially or professionally. Elliot and Dweck further describe competence as

an inherent and fundamental psychological need that drives people to seek competence through behaviors that build competence. County Extension agents, as public servants and professionals tasked with extending accurate and credible information and problem-solving to a diverse clientele, face career-long needs to raise and maintain competency. The positive career motivator with the highest frequency of agreement in a survey of Extension professionals in Colorado was "opportunity to make a difference in the lives of others" (Harder et al., 2014). We believe that by identifying Extension agent competency weaknesses and associations with organized and independent competency development strategies, we can foster the professional development of County Extension agents with targeted and better-designed training programs.

Problem Statement

AgriLife Extension, as with other state Cooperative Extension systems, needs innovative employee training programs that raise competency across several domains. One important competency domain is technical subject matter expertise. In the absence of an internal, agency-sponsored program for county extension agents to gain or raise their expertise in subject areas like horticulture while on the job, three problematic outcomes for extension education delivery in Texas are possible:

1) The quality of client service and programmatic offerings available in some county offices may not meet expectations set by Extension administration or its clients, negatively impacting partnerships and support.

2) Inadequate technical subject matter competency not improved through agency-sponsored employee training may increase job frustration and dissatisfaction for some extension agents. Inability to make a difference in peoples' lives and insufficient opportunities for personal and professional growth may lead to a higher Extension professional turnover rate.
3) High Extension professional turnover rates diminish the fiscal integrity of the cooperative extension service through lost wages, increased hiring costs, and discontinuity in relationships potentially contributing to extramural support.

The growth in demand for recreational and commercial horticulture throughout Texas supports the need for AgriLife Extension to assess competency of Texas County Extension agents in the subject area of horticulture, and to develop professional development strategies that can maintain competency in this subject area while also favorably contributing to both employee retention and client satisfaction.

Purpose and Objectives

Our study purpose was to evaluate organizational preparedness and effectiveness for delivering extension education and problem solving in horticulture in the state of Texas, through a quantitative assessment of the factors that influence county extension agent receptivity to and participation in technical subject matter professional development. The County Extension agents evaluated in this study were those men and women holding the job title of "County Extension Agent" ("CEA") or "County Extension Agent for Agriculture and Natural Resources" ("CEA-ANR"). Agents with these two titles

(hereafter considered synonymous) are tasked with providing assistance to clientele in all technical subjects in agriculture in their county of employment. All other County Extension Agent positions were excluded, including County Extension Agent for Horticulture ("CEA-HORT"), in an effort to focus on how horticulture is being served in the 230 counties that do not have a dedicated CEA-HORT. We conducted an electronic CEA-ANR survey to meet the following objectives.

1) Determine geographic and population growth factors that increase or decrease demand for horticultural information and problem solving at the county level across Texas.

2) Assess the influences of employment tenure, formal education, and personal experiences with horticulture on agent competency and desire for training in the subject.

3) Compile and evaluate past training exposure and resource utilization by agents that influence perceived need and willingness to participate in organization-led training programs.

We desired an improved comprehension of county agent competency in the subject of horticulture that then would offer strategic direction for professional development, ultimately improving client satisfaction and increasing support of Extension Education in Texas.

Methods and Procedures

With assistance of Drs. Philip Shackelford and Scott Cummings, I developed a questionnaire for electronic delivery and participation on Qualtrics XM web platform. We scrutinized content in the questionnaire for face validity with a panel of seven people chosen from among AgriLife Extension subject matter specialists, regional program leaders, and district extension directors. The instrument was pilot-tested with 22 CEA-ANR agents in administrative District 11 to assess its functionality and identify potential problems. Using Cochran's (1977)modified sample size formula for small populations, we determined a sample size of 127 participants was needed for our main study.

I obtained a sampling frame of 200 current CEA-ANR agents (excluding Dist. 11) from Texas A&M AgriLife Human Resources, and the first recruitment notice was sent on January 31, 2020. Three email reminders followed, according to Dillman's (2007) recommendations for email/web surveys, with a total allowed time for participation of 31 days. We received 151 responses, of which 137 were usable due to wrong job title or missing data, giving a response rate of 68.5% for the main participant group. Since only one related pair of questions on the instrument was modified from the pilot test, and because only 75 days lapsed between the pilot and main survey, twenty-eight response items, including all perception, attitudes, and preference constructs in the instrument were analyzed for differences between the main survey and pilot test groups. A random sample of twenty-two participants from the main survey group was compared to the pilot test group (District 11) by an independent samples t-test ($p < .05$). The only significant

differences found in these 28 items were gender (higher percent female agents in D-11), number of CEA-HORT agents in the district (fewer in D-11), and county population estimate (smaller than the random sample drawn from the other 11 districts). Regardless, none of the perceptions, attitudes or preferences that could be associated to smaller population base or gender were affected, so the D-11 pilot data was added to the main data set and all treated as one sample with a sample size of 158. We disclosed results from the single pair of related questions later in our findings. The potential for non-response error was analyzed according to "Method 1" reported by Linder et al (2001), comparing early and late responders in both main and pilot participant groups. We found no significant differences on ten measurement variables, including two Likert scales.

The instrument contained twenty-four questions. Six questions included multiple Likert items totaling 41 response areas, bringing the total number of requested responses on the questionnaire to fifty-nine (59). Skip logic was used at two locations in the instrument. The first skip logic question forwarded participants who identified as working in a county staffed with a CEA-HORT to the end of the survey, eliminating response bias from agents who may have rarely or never engaged in county horticultural matters. The second skip logic question forwarded agents without a master gardener program in their county beyond those Likert items pertaining to master gardener volunteers. I analyzed the data with IBM SPSS Statistics, Version 26 (IBM Corp.).

Findings

CEA-ANR Descriptive Statistics

The results of this survey are highly reflective of agent experience in Texas and exposure to training methods and strategies within AgriLife Extension. ANR agents participating in this survey consisted largely of men and women who had gained their Extension experience only in Texas (94.9%). Eight individuals (5.1%) reported having worked as an Extension agent elsewhere. Early-career agents, defined in this study as those with five or fewer years total employment service, were thirty-nine percent of participants (38.6%) (Table 8). Twenty-six percent of respondents were middle career-tenured agents with total employment of five to fifteen years, and thirty-five percent (35.4%) were very established ("career") extension agents with total employment over fifteen years. The agency therefore has an approximate 40:60 ratio of early-career to established-career agents, the minority being more at-risk for turnover/defection if not appropriately trained (Allen, 2006), and the majority possibly being less motivated for training, having had significant time to learn on the job or to participate in previous formal training efforts.

Forty-five percent (44.9%) of agents participating were working in their first county, having had no previous employment (Table 8.). Greater than half (56.3%) were employed for five years or less in their current/present position, so the results of this

study may likely be influenced by early career agents that are sensitive to demands for competency, are impressionable, eager to learn and open to competency training opportunities. Only twenty-five percent (25.1%) of ANR agents were employed in their present position for ten years or more. Agents transfer from county to county for promotion opportunities, geographic preference, change of scenery, proximity to family and many other reasons. Some move multiple times early in their career and then settle into a county, as they have success, create relationships, invest in homes, etc. While they do gain experience over time, their intra-agency movement, may lead to changing needs for competency.

Table 8. Texas CEA-ANR Current and Total Employment Tenure

Tenure category	Years of employ-ment	Current position employment frequency	Percent	Previous Extension employment frequency	Percent	Total (current plus previous) employment frequency	Percent
-	0.0	-	-	71	44.9%		
1	0.5 - 2.0	55	34.8%	13	8.3%	37	23.4%
1	2.5 - 5.0	34	21.5%	27	17.1%	24	15.2%
2	5.5 -10.0	28	17.8%	23	14.5%	23	14.6%
3	10.5 -15.0	12	7.5%	11	7.0%	18	11.4%
4	15.5 -20.0	10	6.4%	11	7.0%	16	10.1%
5	20.5-25.0	14	8.8%	2	1.2%	18	11.4%
6	25.5-30.0	2	1.2%			15	9.5%
7	30.5-35.0	1	0.6%			6	3.8%
7	35.5-40.0	1	0.6%			1	0.6%

Agricultural county agent gender in Texas, which like many Cooperative Extension agencies has been predominantly male (Seevers & Foster, 2004), is still strongly weighted with males today (72.6% male vs 27.4% female) (Table 9). Our results bear out that female agents as a group, presently have significantly lower mean total employment tenure (5.1 years vs 14.5 years for men) and significantly lower mean current employment tenure (3.5 years vs 9.4 years for men), as determined by an independent samples t-Test, α=.05 (Table 9). Women appear to represent an important percentage of early-career agents in Texas, thus their perceptions on competency and agent training are likewise important to the outcomes of this study and future professional development strategies.

Table 9. CEA-ANR Gender and Employment Tenure

Gender		Current Position Years of Employment	Total Years of Employment in Extension
Male	Mean	9.4[1]	14.5
	n	114	114
	Std. Deviation	8.7	10.4
Female	Mean	3.5 [1]	5.1
	n	43	43
	Std. Deviation	4.2	5.4

[1]Significance p<.001, Independent t-Test, unequal variances assumed

Agent participation among the twelve administrative districts ranged from 3.2% to 13.9% (Table 10). Segregating these districts geographically shows that districts 1-4, which captures the most northern counties in Texas represented 28.5 percent of

respondents. Districts 10, 11 and 12, which encompass southern counties in the state had a 25.3 percent representation. The far west accounted for 11.4 percent, which was matched by District 8 that represents the Central part of Texas (11.4%). Agents in East Texas (Districts 5 and 9), which includes Houston, Beaumont, and northward to Overton, Texas area, accounted for 23.4% of the survey participation, so the survey is useful to represent agent perspectives across the state as well as demand for horticultural support by clients throughout the state.

Table 10. CEA-ANR Survey Participation by Administrative District of Employment

Region	District & Principal City	Frequency	Percent
Panhandle	District 1-Amarillo	11	7.0
South Plains	District 2-Lubbock	5	3.2
Rolling Plains	District 3-Vernon	10	6.3
North	District 4-Dallas	19	12.0
East	District 5-Overton	19	12.0
Far West	District 6-Fort Stockton	6	3.8
West Central	District 7-San Angelo	12	7.6
Central	District 8-Stephenville	18	11.4
Southeast	District 9-College Station	18	11.4
Southwest	District 10-Uvalde	7	4.4
Coastal Bend	District 11-Corpus Christi	22	13.9
South	District 12-Weslaco	11	7.0
	Total	158	100.0

Twenty-two agents (14.1%) responded that they served in a county that was staffed with a person with a job title of “County Extension agent-horticulture” (CEA-HORT). Such positions provide client outreach and educational programming solely in the area of

horticulture, and usually absolve the CEA-ANR working in that county from having to answer horticultural questions. For this reason, our instrument used skip logic to bypass horticultural questions for participants identifying themselves as working in counties with a CEA-Hort agent on staff. The number of respondents indicating presence of a CEA-Hort in this survey is consistent with the total number of Texas counties equipped as such in 2020, which is twenty-four.

Many Texas ANR agents have little to very basic formal college training in horticulture. Fifty agents (32.1%) had no horticulture coursework in college, and ninety-three (59.6%) had one or "a few" classes (Table 11). Eight individuals (5.1%) had taken enough classes to be considered a minor college degree, and five individuals (3.2%) held some college degree in horticulture, ranging from an associate's degree, up to a doctoral degree in one case. Present AgriLife Extension hiring qualifications for a CEA-ANR degree are for a bachelor-level college degree in some agricultural or closely related subject. We cannot speculate on the distribution of other subject matter degrees held in the current population of ANR agents, but can point out that few individuals with a strong college background in horticulture either seek employment as a general agricultural county agent or are not hired in favor of other persons with other agricultural degrees (or both).

Table 11. CEA-ANR College Education in Horticulture; n=156

Scale Rating	Education Classification	Frequency	Percent
1	I took no horticulture classes in college and have no major or minor degree in horticulture.	50	32.1
2	I took at least one or a few horticulture classes but hold no major or minor degree in horticulture.	93	59.6
3	Although I hold no degree in horticulture, I took enough horticulture classes to be considered a minor degree.	8	5.1
4	I have an Associate's degree in horticulture, but no bachelor or higher degree in this field.	1	0.6
5	I have a Bachelor's degree in horticulture (BA, BS), but no graduate degree in horticulture.	2	1.3
6	I have and post-graduate (M.S. or higher) degrees in horticulture.	1	0.6
7	I obtained a Masters or Doctorate degree in horticulture, but hold a Bachelor's degree in another discipline.	1	0.6

Note: Mean 1.84, SD .869

People can learn horticulture practices and techniques informally through personal engagement in a myriad of gardening, landscaping or crop production activities. Many ANR agents in our study appear to have compensated for their lack of previous college training in horticulture with personal experiences that gave them a belief that they had from basic knowledge to increasing levels of proficiency with the subject (Table 12). Despite the high frequency that reported little to college coursework, only fourteen respondents (9%) rated themselves as being unfamiliar to having a minimal understanding (Rating 1 or 2) and fifty respondents (32.1%) rated themselves a "3", indicating a basic knowledge gained from a small number of direct personal experiences. Ninety-two agents placed themselves in either the "moderate" (42.9%) or "many

experiences" (16%) category, meaning they believed their exposure had given them a "reasonably good grasp" or some competency in the subject.

Table 12. CEA-ANR Informal Personal Experiences in Horticulture; n=156

Response Scale	Personal Experience	Frequency	Percent
1	I've really had no direct personal experiences or outside employment in horticulture. This is a subject area I am personally unfamiliar with.	2	1.3
2	I've had very few direct experiences in horticulture. My knowledge and understanding in this subject area is minimal.	12	7.7
3	I've had a few or small number of direct experiences in horticulture. My limited experience has given me some basic knowledge in this subject area, but there is much I don't know or am unfamiliar with.	50	32.1
4	I have had a moderate amount of direct private or professional experiences in the area of horticulture. I have a reasonably good grasp on this subject area, but also have room to improve.	67	42.9
5	I have had many direct experiences in the area of horticulture, either privately or professionally, that have helped me become proficient in this subject area.	25	16.0

Note: Mean 3.65 Median 4.0, SD .886

County Descriptive Statistics

Our questionnaire asked agents to report an estimate of their county population, which ranged from a low of 300 to a high of six million total people (Table 13). Seven agents, with a combined frequency of 5.4%, worked in large urban counties with populations greater than 640,000. These counties, although not identified, likely contain some of the largest cities in Texas, including Houston, Dallas, Fort Worth, San Antonio and Austin. Another eleven agents (8.3%) reported working in large, "neo-urban" counties with populations of 160,000 to 640,000 people; some likely being high growth centers adjacent to the urban counties. Agents working in large counties with population

estimates from 80,000 to 160,000 people also had a frequency of eleven (8.3%). Agents working with moderate county population, designated in this survey by population estimates between ten thousand and eighty thousand people, had the highest collective frequency at 71 (53.7%). Thirty-two agents (24.2%) reported a more rural-like population with 10,000 or fewer people. While depicting the diversity in county population that extends across Texas, this survey also likely captures the variation in demand for county agents to be knowledgeable across a range of agricultural subjects, including horticulture.

We also asked agents to subjectively rate their perception of the current population growth trend in their county of responsibility into one of five categories (Table 14). Nineteen respondents (12%) perceived that their county was experiencing a decline in population, and forty-six (29.1%) rated their county as static/stable. Ninety-three respondents (58.9%) chose a growing county population (slow, moderate or rapid), with moderate growth having the highest frequency (27.2%) within the "growth responders" group. I converted dounty population estimates to a seven-point ordinal scale that combined all values greater than 160,000 into the highest bracket "Level 7" (Table 13). I then correlated these converted population ratings to the five-point population trend ratings (Table 14) using Spearman's rho procedure. I found a moderate positive correlation ($r=.671$), significant at $\alpha<.01$ level, in the predicative relationship between those two subjective ratings. For higher county populations, agents more frequently perceived a growing population, supporting what is known about population growth

areas in urban areas, that it similarly influences growth in the surrounding counties near them (Lawrence, 1988).

Table 13. Texas County Population Reported by CEA-ANR (n=132) and by the U.S. Census Bureau (2019)

Population Range	Population Ordinal Scale	Frequency reported by ANR Agents, n=132	Percentage	Frequency reported by U.S. Census Bureau[1]	Percentage
Less than or equal to 3,000	1	13	9.8%	29	11.4%
3001 to 10,000	2	19	14.4%	59	23.2%
10001 to 20,000	3	23	17.4%	42	16.5%
20001 to 40,000	4	25	18.9%	43	16.9%
40001 to 80,000	5	23	17.4%	33	13%
80,001 to 160,000	6	11	8.3%	19	7.5%
160,001 to 320,000	7	6	4.5%	12	4.7%
320,001 to 640,000	7	5	3.8%	7	2.8%
640,001 to 1.0 M	7	3	2.3%	4	1.6%
1.01M to 2.0 M	7	0		2	0.8%
2.0 M to 3.0 M	7	2	1.5%	3	1.2%
3.0 M to 4.0 M	7	0		0	0%
4.0 M to 5.0 M		1	0.8%	1	0.4%
5.0 M to 6.0 M		1	0.8%		0%

[1]Source- https://txcip.org/tac/census/morecountyinfo.php?MORE=1044

Table 14. CEA-ANR Rating of County of Employment Population Growth Trend; N=158

County growth trend category	Frequency	Percent
Declining population.	19	12.0
Static/stable population--no perceptible change.	46	29.1
Slow growing population.	27	17.1
Moderately growing population.	43	27.2
Rapidly growing population.	23	14.6

We intended two questions on the instrument to assess the within-county clientele demand for horticultural information in Texas. A three-category ordinal scale was presented to capture agents' perceived relative importance of horticulture topics and interests compared to other agricultural subjects they manage in their county of responsibility (Table 15). Twenty-seven respondents (20.3%) rated horticulture interests and topics as "not very important" and requiring little of their overall Extension time and effort. Almost half of respondents (46.6%) rated the subject as of moderate importance, defined in the response scale as "important", but not elevated above other agricultural subject areas in the county. One third of the agents (33.1%) however, rated horticultural interests and topics as "very important" and requiring a "good deal" of ANR agent time.

Table 15. CEA-ANR Perception of the Interest in Horticultural Information Among County Clientele, n=133

Response Scale	Description of importance:	Frequency	Percent
1	Horticultural interests and topics are NOT very important in my county; I spend little time on this subject.	27	20.3
2	Horticultural interests and topics are moderately important in my county, and I spend similar time on horticulture as I do other agricultural science disciplines (range mgt., animal science, etc.).	62	46.6
3	Horticultural interests and topics are very important in my county, and I spend a good deal of time answering horticultural questions.	44	33.1

Note: Mean 2.13, Median 2.0, SD .722

We also asked agents to rate their own perception of change in demand for horticultural information since the time that they began working in the county (Table 16). Thirty-two agents (24.3%) scored the change in the lowest three categories (1, 2, or 3) collectively, indicating no to very little change in demand. The central four change in demand ratings (4, 5, 6, 7), signifying moderate increase in demand, collected responses from seventy-three agents (55.3%). Twenty-seven respondents (20.5%) selected high to very high increases in demand for horticultural information and assistance. The CEA-ANR perspective therefore is that approximately seventy-five percent (75.8%) of Texas counties have experienced moderate to high increases in the demand for horticultural support from the clientele they serve. The two horticultural demand indicators used in the questionnaire had a moderate positive correlation with one another (r=.632, Spearman rho), significant at α.=.01 (2-tailed). Where demand for horticulture assistance

by clientele in certain Texas counties is strong, the predictive relationship we found in this data suggests that demand is also increasing over time.

Table 16. CEA-ANR Perceived Change in Demand for Horticultural Information and Problem Solving in Present County of Employment, From Start Date (in current position) to Present Day, n=132

Rating	Frequency	Percent
1 (No change in client demand)	15	11.4
2	7	5.3
3	10	7.6
4	7	5.3
5 (Moderate increase in client demand)	32	24.2
6	13	9.8
7	21	15.9
8	16	12.1
9	8	6.1
10 (Very high increase in client demand)	3	2.3

To further understand which ANR agents in Texas need competency in the subject of horticulture, I explored the predictive relationship of county population to within-county client demand for horticulture and change in that demand with a non-parametric correlation procedure (Spearman rho), using county population rankings shown in Table 4. A moderate positive correlation (r=.523) was found between county population rankings and ratings of client interest. This correlation was significant at α=.01 level (2-tailed). The correlation between population level score and change in client demand ratings was lower (r=.444), but also moderately positive and significant at α=.01 level. Population expansion usually signifies increases in single-family and/or multi-family

housing construction (houses and apartments), which then raise the quantity and quality of landscaping efforts in those areas of expansion (Lawrence, 1988; Niemera, 2016).

I conducted a one-way analysis of variance on both the 3-point client interest in horticulture rating and the perceived change in demand ratings against the seven ordinal categories of county population. For perceived change ratings (1-10), homogeneity of variances assumption was not violated, according to Levene's test (p= .187). Mean population ratings 1 & 2, which contained county populations of 10,000 and fewer people, had significantly lower perceived changes in client demand for horticulture than population levels 6 and 7 that contained counties with populations greater than 80,000 people, according to Tukey' HSD post-hoc test, α=.05 (Table 17).

Table 17. One-Way Analysis of Variance, Comparing Perceived Change in Client Demand for Horticulture Among Seven County Population Classifications

County Population Rating	N	Mean
1	10	2.90 a[1]
2	18	4.11 a
3	23	5.43 ab
4	24	5.54 ab
5	20	5.60 ab
6	9	7.89 b
7	4	7.50 b

[1]Means within columns with the same letter are not significantly different, Tukey's HSD, α=.05.

I analyzed mean client interest/demand ratings for differences between seven county population levels using the Kruskal-Wallis Test, since Levene's test for homogeneity was significant (p=.002) (Table 18). Mean population levels 1 and 2, which included those agents working in counties with 10,000 or fewer people, were not different from one another, but had significantly lower client interest ratings than levels 6 and 7. The two highest population rankings (6 & 7), in addition to being higher than 1 and 2, were also significantly higher than population levels 3 and 4. Perceptions of horticultural client demand among agents tend to increase with population increase. Agents working in counties with 10,000 or fewer people do not perceive horticulture as very important in their county on average. At a county population of 80,000 or higher, ANR agents do perceive horticulture as very important in their county. We do not fully know the cause and effect relationship between population size and horticultural demand. It is likely tied to a combination of factors including, increased leisure activities that involve gardening and outdoor space usage, tourism and environmental influences on municipal tree and landscaping policies, increased interest in locally grown food (Low et al., 2015), and the positive effect of landscaping aesthetics on competitive real estate values (Niemera, 2016). These findings are important in helping administrators understand the motivation and desire for training held by Texas ANR agents, as well as the organizational development strategies needed to raise competency and improve client satisfaction.

Table 18. CEA-ANR Perceived Client Demand for Horticultural Information and Problem Solving for Seven Texas County Population Classifications

County Population Rating	Mean Client Demand for Horticultural Information Rating[1]	n	Std. Deviation
1	1.4 a[2]	10	.52
2	1.7 ab	18	.58
3	2.1 b	23	.63
4	2.0 b	24	.72
5	2.3 bc	20	.66
6	3.0 c	9	.00
7	3.0 c	4	.00

Notes: [1]Demand Ratings: 1= Horticultural interests and topics are not very important in my county; 2=. Horticultural interests and topics are moderately important in my county; 3= Horticultural interests and topics are very important in my county (from Table 15). [2]Means within columns with the same letter are not significantly different, Independent Samples Kruskal-Wallis test, α=.05.

A potentially influential factor in agent perceptions and time devotion to horticulture is the presence or absence of a county Master Gardener association. Master Gardeners are local community volunteers that are formally trained in the subject of horticulture in a coordinated educational program developed and delivered by Extension subject matter specialists and County Extension agents employed by AgriLife Extension. Texas presently has approximately seven thousand master gardener volunteers in the state (J. Fry, State MG Coordinator, personal communication). The county master gardener groups are set up as private, not-for-profit associations that independently conduct their own fund-raising and social activities. Volunteers are recruited and trained in their county of residence to provide assistance in their county by building and maintaining community gardens, plant sales and public education programs, and answering telephone questions or emails about horticulture that are brought to the County Extension office.

Volunteers may join associations that are not their county of residence if their own county does not have an association. Associations are usually headquartered in a single county that works in conjunction with the local County Extension staff of that county. Multi-county master gardener associations occur when interest within a single county is insufficient to sustain a single-county association.

Skip logic in our Qualtrics survey advanced CEA-ANRs that reported having a CEA-HORT in their county past all questions dealing with perceptions of horticultural demand, resource availability, and presence of a master gardener association. Master Gardener associations (single county or shared with one or more other counties) occurred in approximately forty-five percent (44.7%) of the Texas counties participating in the study that did not have a CEA-HORT Agent (n=132). It is known from administrative records that 100% of counties with a CEA-HORT position staffed in the county also have a single county master gardener association (Fry, 2020). We inferred then that the twenty-two participants in this study that reported having a CEA-HORT position also had a master-gardener association, increasing the percentage of Texas counties having a master gardener association above fifty percent (52.6%, n=156), although not reflected in this data.

ANR agents from counties with the lowest populations (below 3,000 people) in this study did not have Master Gardener associations and did not participate in shared, multi-county associations (Table 19). Master Gardener associations were likewise low in

counties with from three to twenty thousand people, accounting for 6.8% of the counties with master gardener presence and 23.5% of counties with no master gardener presence. The high population counties represented in this study, those with 160,000 people or greater appear from these results to have very little Master Gardener presence (3.1%), only because of the survey skip logic that removed those twenty-two ANR agents who were working in a county with a CEA-HORT on staff. These high Texas county population levels, as seen in Table 20, accounted for 63.6% of the respondents who worked with a horticulture agent. Using census data and known staffing of horticulture agents, these population levels in actuality account for 83.4% of agents working with CEA-HORT and thus have a Master Gardener association. The intermediate population categories, from 20,000 to 160,000, showed modest presence of Master Gardener associations with 24.2 percent of those counties having either a single or multi-county association and 15.1 percent having neither (Table 19). Since perceived client demand for horticulture information was significant at county populations of 80,000 or greater (Table 18), the modest presence of Master Gardener associations in this county population bracket is a potential shortcoming of Extension programming in counties of that size, if it can be shown that master gardener associations are a benefit in meeting the demand for horticulture information.

Table 19. Master Gardener Volunteer Distribution Among Surveyed CEA-ANR not Having a CEA-HORT on Staff

County population	Has Single County Association (Frequency)	Percent	Participates in Shared (Multi-County) Association (Frequency)	Percent	Combined Percentage (Single or Shared)	No Master Gardener Association	Percent
<3,000	0	0.0%	0	0.0%	0%	10	7.6%
3,001-10,000	2	1.5%	1	0.8%	2.3%	15	11.4%
10,001 to 20,000	2	1.5%	4	3.0%	4.5%	16	12.1%
20,001 to 40,000	10	7.6%	2	1.5%	9.1%	11	8.3%
40,001 to 80,000	10	7.6%	1	0.8%	8.3%	9	6.8%
80,001 to 160,000	8	6.1%	1	0.8%	6.8%	0	0.0%
160,001 to 320,000	3	2.3%	0	0.0%	2.3%	0	0.0%
320,001 to 640,000	1	0.8%	0	0.0%	0.8%	0	0.0%
640,001 to 1M	0	0.0%	0	0.0%	0.0%	0	0.0%
1.01 M to 6.0 M	0	0.0%	0	0.0%	0.0%	0	0.0%
No County Population Estimate given	13	9.8%	1	0.8%	10.6%	12	9.1%
Total	49	37.1%	10	7.6%	44.7%	73	55.3%

Table 20. CEA HORT Presence Versus County Population Estimate, n=22

County Population	CEA-HORT Presence in County (Frequency)	Percent	Known distribution of counties with CEA-Hort positions in Texas (n=24) versus 2019 Texas Census data	Percent
<3,000	0	0%	0	0%
3001 to 10,000	0	0%	0	0%
10,001 to 20,000	0	0%	0	0%
20,001 to 40,000	1	4.5%	2	8.3%
40,001 to 80,000	2	9.1%	1	4.17%
80,001 to 160,000	2	9.1%	1	4.17%
160,001 to 320,000	3	13.6%	4	16.7%
320,001 to 640,000	4	18.2%	6	25.0%
640,001 to 1M	3	13.6%	4	16.7%
1M to 6M	4	18.2%	6	25.0%
No County Pop. estimate given	3	13.6%		

Agent Experiences, Perceptions and Attitudes

We attempted to assess ANR agent perception of the benefit or drawbacks of Master Gardener association presence in the county with three, five-point Likert items on our instrument (Table 21). Skip logic in our Qualtrics software limited the respondents to fifty-nine agents that indicated they had their own county association or shared in a

multi-county association. Questionnaire items MG1 and MG2 were to elucidate whether agents perceived that the presence and engagement of "volunteer horticulturists" assisted meeting the client demand for horticultural information and problem solving. A majority of participants (52.6%) agreed with item MG1, that Master Gardener associations were "an effective resource" for answering questions and assisting with county problems in horticulture (Table 21). Twenty percent disagreed and 27.1% were undecided. Disagreement (strongly disagree and disagree) was the majority however for Item MG2, which asked whether master gardener associations reduced the need for ANR agents to "stay abreast of horticultural topics and problems in the county". MG2 had a high percent of undecided respondents (37.2%) and a low percentage of agreement (10.2%). We inferred from the neutrality/indecision and low agreement in MG2 that the benefits perceived in Item MG1 by a majority of respondents were offset by other factors or consequences of Master Gardener association presence that would prevent the Extension agent from being completely absolved of engagement in county horticulture matters. In fact, Item MG3, the reciprocal of MG2, had nearly fifty percent agreement (48.9%) with the statement that master gardener associations 'increase the need for those agents to stay abreast of horticultural problems and topics. ANR agents typically engage Master Gardeners by coordinating their training schedule/format and teaching significant portions of new Master Gardener trainee education. This educational role, as well as ongoing coordination of volunteer activities in the county, likely increases the time spent on horticulture by ANR agents compared to those without a Master Gardener association.

Table 21. CEA-ANR Perceptions of the Contribution of a Master Gardener Program to External Client Horticultural Information and Assistance; n=59

Questionnaire Item	Disagree Strongly (1)	Disagree (2)	Neither Agee or Disagree (3)	Agree (4)	Agree Strongly (5)	Mean	SD
MG1-"The Master Gardener volunteer program associated with my county is an effective resource for answering horticultural questions and problems in my county".	6 10.2%	6 10.2%	16 27.1%	23 39.0%	8 13.6%	3.4	1.2
MG2-"The Master Gardener program reduces my need to stay abreast of horticultural topics/problems in my county".	13 22%	18 30.5%	22 37.3%	5 8.5%	1 1.7%	2.4	1.0
MG3-"The Master Gardener program increases my need to stay abreast of horticultural topics/problems in my county".	4 6.8%	10 16.9%	16 27.1%	20 33.9%	9 15.3%	3.3	1.1

ANR agent participants self-selected their category of past participation in nine types of potential agent training events during their total tenure of employment (Table 22). Extension agency-led face-to-face training events, developed specifically for agents and conducted within their own respective administrative district, had the highest mean score of 2.7, followed by agency-sponsored live webinars organized for agents at 2.6. County agents frequently utilize Extension-led events for general clientele, like the Texas Beef Cattle Short Course, as training opportunities, which had a mean category participation of 2.5, and was higher than agency-sponsored agent trainings conducted outside of respective administrative districts (2.3). Agents reported having participated in non-agency sponsored live webinars and recorded events developed for agents or for the

public, but those forms of training had lower participation frequencies than all agency-sponsored forms of training.

Table 22. CEA-ANR Participation in Professional Development Trainings, n=157

Type of Training Experience	Not at all (1)	1 to 10 times (2)	11 to 20 times (3)	21+ times (4)	Mean	SD
Agency-Sponsored Face to Face Trainings in my District	4	84	28	41	2.7	0.89
	3%	54%	18%	26%		
Distance-taught Agency-Sponsored Webinar, Live Event	7	90	27	33	2.6	0.87
	4%	57%	17%	21%		
Agency-Sponsored Face to Face Trainings conducted for anyone (Beef Cattle Shortcourse)	15	93	28	21	2.5	0.83
	10%	59%	18%	13%		
Agency-Led Face to Face Trainings anywhere in Texas	13	103	30	11	2.3	0.70
	8%	65%	19%	7%		
Distance-Taught recorded event for agents, produced by Agency	16	104	22	15	2.2	0.75
	10%	66%	14%	10%		
Distance-taught Non-Agency-Sponsored Webinar, Live Event for agents	44	95	15	3	1.9	0.65
	28%	60%	10%	2%		
Distance-taught Webinar, Live Event for anyone	49	87	15	6	1.9	0.73
	31%	55%	10%	4%		
Distance-Taught recorded event for agents, produced by Non-Agency	48	94	7	8	1.8	0.73
	30%	60%	4%	5%		
Distance-Taught recorded event for anyone	58	90	5	4	1.7	0.65
	37%	57%	3%	3%		

I converted training ratings (1, 2, 3, 4) to numerical estimates of training experiences (0, 5, 15, or 21 times) and grouped them into two summation categories: “agency training,” and “external training.” Analysis of variance using Extension district as a factor was not

significant for both training categories (p=.185 agency training; p=.253 external training). The administrative leadership strategies that influence or require agents to participate in professional development activities seem equally applied across the twelve administrative districts in Texas. Likewise, agents of all districts appear to pursue outside training similarly. The computed scale variable "agency training" had a moderate positive correlation (Pearson's r=.483) to total years of Extension employment tenure. The second computed scale variable "external training" also exhibited a moderate positive correlation to length of Extension employment (r=.405). Both training variable correlations to employment length were significant at α=.05. While longer tenures of employment might naturally be expected to increase an agent's training experiences, these results support that professional development efforts by AgriLife Extension have been and continue to be an ongoing effort.

Analysis of variance using total employment tenure categories as a factor for comparison of agency-sponsored and external training frequency found significant difference in both training experience types (agency-sponsored and external) between the shortest agent employment tenure category (0.5 to 5.0 years) and the longest tenured category of greater than 30 years (Table 23). However, when divided over employment years, these mean training experiences show that newer agency employees are incurring more trainings per year compared to older employees, possibly due to the increased accessibility to distance-taught training opportunities. In fact, when compiling all distance live and recorded training categories into one summation variable named

"distance training", new employees (0.5 to 5 years tenure) averaged 6.4 trainings/year of employment compared to 1.2 trainings per year of employment for employees of 30 years tenure or more (Table 23).

Table 23. One-Way Analysis of Variance for Agency-Sponsored, External, and Distance Training Experienced by Texas ANR Agents

Employment Tenure Category	n	Agency Training	External Training	Distance Training
1	61	23.9 a[1]	18.1 a	16.1 a
2	22	33.4 ab	26.9 ab	26.0 ab
3	18	50.4 ab	32.6 ab	28.7 ab
4	16	42.3 ab	29.3 ab	25.9 ab
5	18	35.2 ab	29.1 ab	24.4 ab
6	15	50.9 ab	40.3 ab	33.3 b
7	7	62.1 b	50.1 b	40.0 b

[1]Means within columns with the same letter are not significantly different, Tukey's HSD, α=.05.

ANR agents like face-to-face educational programs more than distance-taught live or recorded methods (Table 24.). Workshop-style programs that contained experiential learning elements gave higher frequencies of respondents scoring "like strongly" and higher mean scores across respondents than in-person lectures with slides and traditional visual aids. More agents were neutral (neither liking or disliking) regarding the distance options for training. Recorded webinars that were designed for self-paced completion had the highest frequently of "strongly dislike" ratings. Participating agents were homogenous in their training preferences, because analysis of various produced no significant differences between male and female agents, or among agents in different

administrative districts, county population sizes or with different total length of employment (data not shown).

Table 24. CEA-ANR Preference for Professional Development Training; n=156

Type of Training	Dislike Strongly (1)	Dislike (2)	Neither Like or Dislike (3)	Like (4)	Like Strongly (5)	Mean	SD
Face to face lecture-seminar with slides & other visual aids	0	13	15	90	38	4.0	0.82
	0%	8%	10%	57%	24%		
Face-to-face workshop with some experiential learning features (field/equipment demonstrations, hands-on activities)	0	1	5	45	105	4.6	0.58
	0%	1%	3%	29%	67%		
Distance-taught (live) webinar with participants listening/watching a lecture with visual aids and the ability to interact with presenter(s).	17	30	45	58	6	3.0	1.07
	11%	19%	29%	37%	4%		
Distance-taught (recorded) webinar that participants can watch on their own schedule.	26	33	36	50	11	2.9	1.21
	17%	21%	23%	32%	7%		

We posed questions 19 and 20 in the questionnaire to examine what resources ANR agents turn to when faced with a horticultural problem or question that they could not answer. The first question solicited what participant's usual first action was, and the second asked them to affirm all past strategies used (Table 25). Skip logic prevented ANR agents who identified as working in a county that has a CEA-HORT from

answering these questions. The results for these two questions are compromised, because agents from District 11, who account for fourteen percent (13.9%) of the respondents, participated in the survey in its pilot test form, and were not offered the choice "try to contact a fellow ANR agent in my district, region or elsewhere in the agency" as a response option for either question. Despite this discrepancy in the results, it is useful to show that Extension agents rely heavily on web resources (search engines or known websites) to answer client questions. Going to a known website to find answers, combined with using common internet search engines, captured over fifty percent (51.6%) of agent responses of their usual first step for discovering answers to questions they don't know. These two tactics appeared in 74.4% and 67.6% of agents complete collection of strategies. Communication with specialists as a means to solve horticultural problems was also very important, appearing as the most commonly used strategy among agent participants (85%). It was less frequently the first method used (24.8%), possibly because of the added communication time involved. ANR agents also used CEA-HORT and fellow ANR agents staffed in their district, as well as Master Gardeners or other local citizens to help them with challenging horticultural issues that arise. One hundred percent of respondents used multiple assistance strategies, and 46.6% used at least four methods of assistance, demonstrating that horticulture is a broad-based and diverse agricultural subject, causing Extension agents of diverse education and experience to be creative and flexible in their attempts to answer questions and provide help to local clientele.

Table 25. Usual First Method and All Methods Used by ANR Agents for Managing Client Horticultural Questions or Problems; n=133

Method or Strategy	Frequency of agent's first response	Percent	Frequency of all methods employed	Percent
Go to a website I know that I expect to have the answer.	48	36.1%	99	74.4%
Try to contact an Extension Specialist/Program Specialist by Email, Phone, Lync, etc.	33	24.8%	113	85.0%
Search the Internet--Google, Yahoo, Bing, etc.	22	16.5%	90	67.6%
Try to contact a CEA-Horticulture Agent in my district, region or elsewhere in the agency.	14	10.5%	84	63.2%
Try to contact a fellow ANR Agent in my district, region or elsewhere in the agency.	10	7.5%	85	63.9%
Ask a Master Gardener or other knowledgeable person in my county.	5	3.8%	40	30.1%
Ask the question on eXtension 'Ask an Expert' website.	0	0%	8	6.0%
Other—not specified	n/a	n/a	19	14.3%
Total	133	100.0	538	

Our questionnaire presented agents with twenty-five Likert items in three subsets, crafted to understand the importance ANR agents themselves place on gaining competency in technical subjects, and whether they gravitate more toward formal training or independent self-directed learning. Two subsets of these items targeted perceptions of need for training in horticulture science specifically, as well as availability of supportive online resources and Extension subject matter specialists that

could affect whether an agent felt sufficiency for managing local horticultural issues without being highly competent in the subject themselves.

Subset 1 contained eleven Likert items designed to assess agent agreement or disagreement that technical subject matter competency, across agricultural subjects in general, is important to an agent's career. We presented these items in the early section of the instrument, preceding all discussion of horticulture, and thus the sample size (N=158) was not reduced by skip logic that limited agent participation, as it did further along in the instrument to those without a CEA-HORT agent staffed in their county. The phrasing on seven items (#'s 1, 2, 3, 4, 6, 7, 8) reflected positive feelings and association with competency and organized training methods ("pro-competency"), and the phrasing on five items (#'s 5, 9, 10, 11) reflected negative associations toward gaining competency (Table 26).

Table 26. *Subset 1*-CEA-ANR Perceptions and Attitudes Toward Technical Subject Matter Competency and Organized, Agency-Led Training Programs; N=158

Item	Statement	Disagree Strongly (1)	Dis-agree (2)	Neither Agree or Dis-agree (3)	Agree (4)	Agree Strongly (5)	Mean	SD
1	Being able to answer questions across a range of agricultural disciplines contributes positively to a county extension agent being successful.	0	1	1	62	94	4.58	0.55
		0%	1%	1%	39%	60%		
2	County agents should be expected to be competent in all agricultural disciplines when they begin their careers.	29	72	27	23	7	2.41	1.08
		18%	46%	17%	15%	4%		
3	It is important for county extension agents to be competent in the priority subjects in their county.	0	1	5	90	62	4.35	0.58
		0%	1%	3%	57%	39%		
4	It is not reasonable to expect county agents to be competent in all agricultural subjects.	5	20	26	69	38	3.73	1.06
		3%	13%	17%	44%	24%		
5	County agents can gain competency in subjects that they were not previously trained in by learning on the job.	0	0	6	79	73	4.42	0.57
		0%	0%	4%	50%	46%		
6	Organized agency-training events are beneficial for agents to gain technical subject matter competency.	0	4	16	75	63	4.25	0.74
		0%	3%	10%	48%	40%		
7	Organized agent training efforts are beneficial and a high priority for me to participate in.	0	6	30	80	42	4	0.78
		0%	4%	19%	51%	27%		
8	Texas A&M AgriLife Extension should develop more organized training events specifically for agent technical subject matter competency.	0	6	23	78	51	4.1	0.78
		0%	4%	15%	49%	32%		
9	Texas A&M AgriLife Extension presently requires too much agent time for technical subject matter competency training.	8	62	74	12	2	2.61	0.76
		5%	39%	47%	8%	1%		
10	Organized agent training efforts are difficult for me, because they compete for my time needed to do other job-associated tasks.	2	32	43	56	24	3.43	1.02
		1%	20%	27%	35%	15%		
11	Organized agent training efforts are difficult for me, because of costs associated with traveling to such events.	5	45	34	56	18	3.23	1.08
		3%	29%	22%	35%	11%		

ANR agent participants generally had a high frequency of agreement with positive concepts of technical subject matter competency and organized training. Items 1, 3, 6, 7, and 8 in Subset 1 had high frequencies of agreement (Agree or Agree Strongly), from 78% to 99%, with low to moderate frequency of undecided feelings (0.6% to 19%) and low frequency of disagreement (Disagree or Strongly Disagree combined), from 0.6% to 3.8%. Item 4, which stated that "it is not reasonable to expect county agents to be competent in all agricultural subjects" likewise had a high majority agreement (67.8%) but garnered more disagreement at 15.9%. The lack of a time qualification in the wording of Item 4 may have created more disagreement in the respondents who have employment tenures from less than one or more than thirty years. Item 2 was a reverse direction-worded statement, asking agents to disagree if they felt that technical subject competency was required at the time they were hired. Disagreement with Item 2 was the majority opinion at sixty-four percent, indicating that agents should be given time to gain competency after being hired, but nineteen percent also agreed, and seventeen percent were undecided.

The negative-associated Likert items in Subset 1 had mixed agreement among ANR agents (Table 26). Item five, which solicited agreement with the concept of learning on the job, had a very high frequency of agreement (96.2% Agree or Agree Strongly), minimal neutrality, and no disagreement. We interpreted this to mean that agents believe in their ability to learn, adapt and gain competency with experience over time. It does not provide any evidence that they don't also value organized training. In fact, only 8.9%

agreed with Item 9 (44.3% disagreed, 46.8% undecided), which stated that “Texas A&M AgriLife Extension requires too much agent time for competency training”. Two items (#10 and #11), which offered potential barriers or obstacles to appreciation of competency training efforts, had moderate levels of agreement (46.8%, 50.6% respectively), with intermediate levels of undecidedness and disagreement. Travel cost and competing job demands for agents’ time are therefore important considerations for administrators, especially if the frequency of undecided responses (Neither Agree or Disagree) is viewed as uncertainty and combined with the agreement responses.

Subsets 2 and 3 of agent competency and training perceptions contained Likert items that assessed competency deficiency (or lack thereof) in the subject of horticulture specifically. We presented these particular questions to participants after skip logic forwarded twenty-two agents that identified as working in a Texas county staffed with a CEA-HORT position to the end of the questionnaire. Thus the 132/133 agents that responded to these items were responsible for horticultural questions and problem solving in their county. Subset 2 contained six items, three presented as positive associations with agency-led competency training for horticulture (#’s 12, 14, 15), and three presented as negative associations (#’s 13, 16, 17). Within the three positively-associated Likert items in Subset 2, Item 15 had the highest frequency of agreement at 71.4% (Agree and Agree Strongly) and lowest frequency of combined disagreement (9.1%) with the statement that “more agency training would be beneficial” (Table 27). Over half of respondents (51.9%) disagreed with Item 14 that they had not received

agency training to help deal with client horticulture issues in their county, indicating that a very slight majority believe they were exposed to training in horticulture. However, with regard to Item 12, only 41.4% agreed (Agree and Strongly Agree) and 33.1% disagreed that they had received training that helped their work in the subject of horticulture. The approximate ten percent difference in horticulture training experience between items 12 and 14, may result from the qualitative component in the wording in the former item which possibly provoked agents to consider whether the horticulture training had been comprehensive enough for them to handle "most horticulture questions and problems". The degree of diversity in horticulture problems and issues may have caused some agents to feel deficient in their ability to handle "most" issues, even though they had received training in the subject.

Table 27. *Subset 2*-CEA-ANR Perceptions and Attitudes Toward Competency and Organized, Agency-Led Training Programs in Horticulture; n=133

Item	Statement	Disagree Strongly (1)	Dis-agree (2)	Neither Agree or Disagree (3)	Agree (4)	Agree Strongly (5)	Mean	SD
12	I have received agency training that has helped me be able to handle most horticulture questions and problems in my county:	6 4.5%	38 28.6%	34 25.6%	50 37.6%	5 3.8%	3.1	1.0
13	I have received agency training in horticulture, but it has not helped me enough in my ability to handle horticultural questions and problems:	10 7.5%	44 33.1%	50 37.6%	27 20.3%	2 1.5%	2.8	0.9
14	I have not received agency training to help me deal with horticulture questions and problems in my county.	25 18.8%	44 33.1%	26 19.5%	30 22.6%	8 6.0%	2.64	1.2
15	More agency training in the subject area of horticulture would help me as an extension agent.	3 2%	9 7%	26 20%	62 47%	33 25%	3.9	1.0
16	Specialist availability and online resources are adequate for me to manage horticultural questions and problems in my county without additional training	2 2%	30 23%	38 29%	51 38%	12 9%	3.3	1.0
17	I can increase my ability to manage horticultural questions and problems on my own well enough without additional agency training.	11 8%	42 32%	50 38%	25 19%	5 4%	2.8	1.0

We found only moderate agreement with three items in Subset 2 that attempted to identify negative perspectives about horticultural training (#'s 13, 16, 17) (Table 27). Approximately forty percent of respondents disagreed, and 21.6% agreed with item 13 that they had received training in horticulture, but that it had not been helpful. The frequency of disagreement for Item 13 relates well to the agreement frequency in Item

12, supporting a conclusion that about 40% of ANR agents have had some improvement in their horticulture competency through agency training. A greater majority though, either feel that training has not raised competency, or they are unsure about that. Less than half of participating agents (47.3%) felt supported enough through subject matter specialist availability and online resources (digital fact sheets, videos, blogs, etc.) to not need additional horticultural training (Item 16-Table 20), and only 22.6% agreed that they could be successful at increasing their horticultural competency on their own, without agency-led training (Item 17). It appears that the confidence in self-directed learning on the job shown by agent responses to Item 5 in Subset 1 is lower when asked to consider horticulture specifically. Those Extension agents exposed to county horticulture questions and problems perhaps had gained some understanding that the diversity of the subject necessitates training.

The response items in "Subset 3" of our instrument focused on supportive resources that could increase or decrease an agent's own need to gain competency in the subject of horticulture. We worded four items (#'s 18, 19, 20, 21) to attempt to gain insight about how agents' view the support they are given by Extension subject matter. Item 18, which directly assessed agent confidence in the ability of subject matter specialists in horticulture to provide answers to questions, had a high frequency of agreement (89.3%) among respondents and low disagreement (1.5%) (Table 28). Items 19 and 20 solicited feedback on the speed of communication between agents and specialists by phone and email. Both items garnered a majority agreement among respondents at 61.4% and

67.4% respectively, but also revealed moderate indecision and disagreement of nine to eleven percent, indicating that speed of communication was a concern for some agents. Item 21 was reverse-worded to assess further the status of agent-specialist communication, and the frequency of agreement (29.6%) substantiated our inference that some agents perceive that communication with specialists could be improved.

Extension educational resources are an important tool to close the gap between agent subject matter competency and client satisfaction. Resources that can be trusted by agents are valuable for management of point-in-time questions and problems (Bailey et al., 2014). Four Likert items in Subset 3 assessed the sufficiency and organization of online resources for supporting ANR agents and external clientele. Items 22 and 24 asked agents for agreement that their online resources across all agricultural subjects were sufficient (Item 22) and locatable (24), whereas items 23 and 25 asked the same questions about horticulture resources specifically. The agreement frequency (Agree and Agree Strongly) was a moderate majority across all four items, ranging from fifty-three to sixty-four percent, with low-moderate disagreement of eighteen to twenty-four percent. The horticulture questions had slightly better agreement/disagreement frequencies than the same questions asked about all agricultural subjects. These results imply that an important minority of Texas County Extension agents need additional resources, and do not feel so well provisioned that competency training would be unwanted or unneeded.

Table 28. *Subset 3*-CEA-ANRPerceptions and Attitudes about Supportive Resources that Offset Technical Subject Matter Competency; n=132

Item	Statement	Disagree Strongly (1)	Disagree (2)	Neither Agree or Disagree (3)	Agree (4)	Agree Strongly (5)	Mean	SD
18	Specialists and Program Specialists in Extension Horticulture usually know the answer to horticulture questions that I cannot answer.	0	2	12	79	39	4.2	0.7
		0.0%	1.5%	9.1%	59.8%	29.5%		
19	Specialists and Program Specialists in Extension Horticulture return phone calls in a timely manner.	3	11	37	71	10	3. 6	0.8
		2.3%	8.3%	28.0%	53.8%	7.6%		
20	Specialists and Program Specialists in Extension Horticulture reply to Emails in a timely manner	1	11	31	77	12	3. 7	0.8
		0.8%	8.3%	23.5%	58.3%	9.1%		
21	I cannot always be assured that questions will be answered in a timely manner and need additional resources.	5	46	42	34	5	2.9	1.0
		3.8%	34.8%	31.8%	25.8%	3.8%		
22	Online resources (fact sheets and web content) created by AgriLife Extension across all agricultural subjects is sufficient for me to help clients in my county.	4	23	35	61	9	3.4	1.0
		3.0%	17.4%	26.5%	46.2%	6.8%		
23	Online resources (fact sheets and web content) created by AgriLife Extension in the subject area of Horticulture is sufficient for me to help clients in my county.	3	20	35	66	8	3.4	0.9
		2.3%	15.2%	26.5%	50.0%	6.1%		
24	I know where to go within AgriLife Extension resources to find information across all agricultural subjects.	5	27	25	64	11	3.4	1.0
		3.8%	20.5%	18.9%	48.5%	8.3%		
25	I know where to go within AgriLife Extension resources to find information pertaining to Horticulture.	3	20	25	70	14	3.6	1.0
		2.3%	15.2%	18.9%	53.0%	10.6%		

Assessment of Research Questions

We assessed potentially influential classification factors behind ANR agent responses to the Likert items in the three-agent perception/reaction subsets, by creating two Likert measurement scales. The first scale, named "Horticulture Pro-Training," averaged scores from six items in subsets 1 and 3 (#'s 1, 3, 6, 7, 8, 19) had a grand mean of 4.2 and standard deviation of .45 (Table 29). The reliability of Horticulture Pro-Training was acceptable, having a computed Cronbach's alpha of .654. Gall, Borg and Gall (1996) place acceptable reliability values at Cronbach's alpha values greater than 0.70; however, other authors place an acceptable alpha level for reliability at 0.6 to 0.70 interest in organized competency training, especially focused on horticulture. Figure 4.1 depicts the distribution of CEA-ANR response on this scale.

Table 29. *Horticulture Pro-Training* Likert Scale

Subset Item #:	Statement	Mean[1]	SD
1	Being able to answer questions across a range of agricultural disciplines contributes positively to a County Extension agent being successful.	4.6	0.6
3	It is important for County Extension agents to be competent in the priority subjects in their county.	4.4	0.6
6	Organized agency-training events are beneficial for agents to gain technical subject matter competency.	4.3	0.7
7	Organized agent training efforts are beneficial and a high priority for me to participate in.	4.0	0.8
8	Texas A&M AgriLife Extension should develop more organized training events specifically for agent technical subject matter competency.	4.1	0. 8
19	More agency training in the subject area of horticulture would help me as an Extension agent.	3.9	1.0
	Scale Statistics	4.2	0.45

Note: Cronbach's α=0.654; [1]1=Disagree Strongly, 2=Disagree, 3=Neither Disagree or Agree, 4=Agree, 5=Agree Strongly

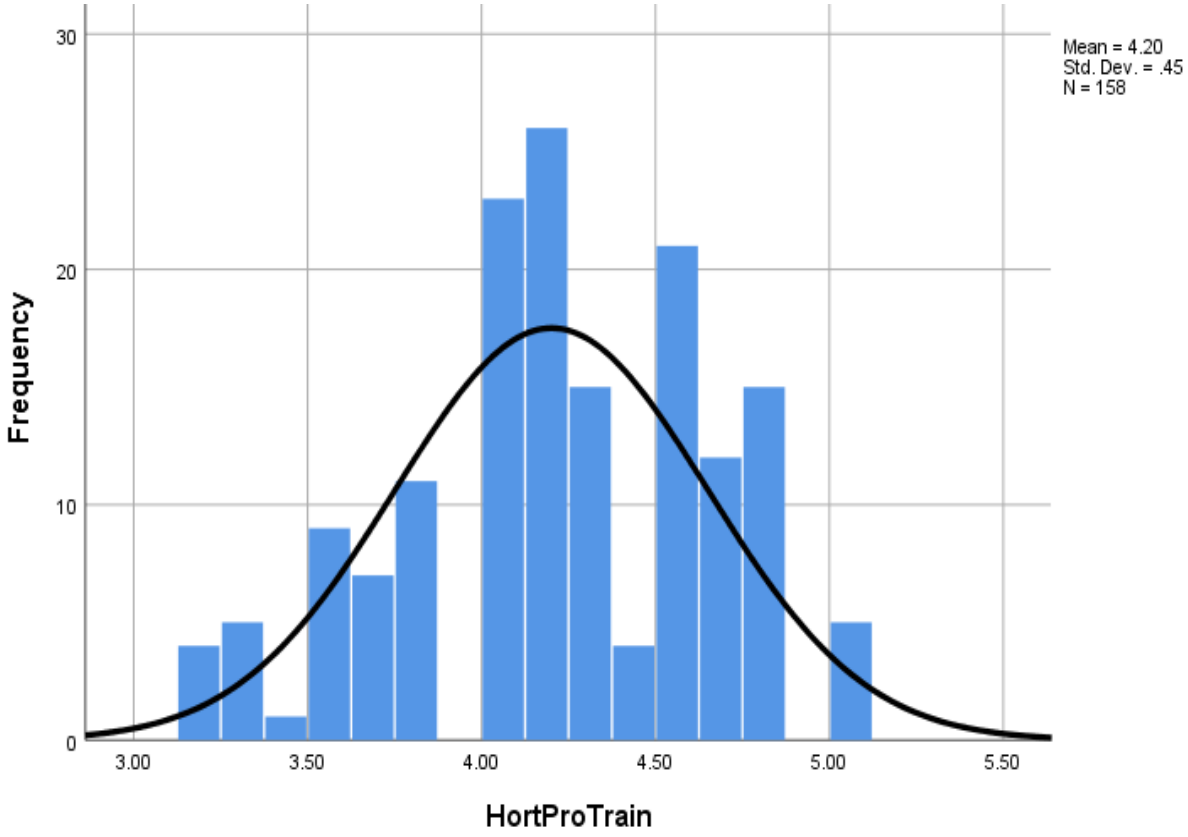

Figure 4.1. CEA-ANR Frequency of HortPro-Training Scores. 1=Disagree Strongly, 2=Disagree, 3=Neither Agree or Disagree, 4=Agree, 5= Agree Strongly.

We evaluated several respondent classification factors with analysis of variance or independent samples t-test (gender). Agent employment tenure, employment district, gender, horticultural education, county population rating, client perceived interest in horticulture, change in client demand, presence/absence of a Master Gardener association were not significant (α=.05) (data not shown). Informal horticulture experience was significant at α=.10 (p=.094). Post-hoc mean separation with Ryan-Einot-Gabriel-Welch showed Hort Pro-Training scores for the most horticulturally

experienced agents and those with a few experiences to be significantly higher than those for the no experience agent group (Table 30). Agents therefore who have a basic familiarity with the technical depth and breadth of horticulture, also value its training more than those with no experience in the subject. It is possible that they place more importance and value on what organized training can provide in the way of increased competency. It is also possible that their previous experience resulted from personal pursuit and enjoyment, which in turn increased their desire or value in additional organized training in horticulture.

Table 30. One-Way Analysis of Variance of Horticulture Pro-Training Scores for CEA-ANR Previous Personal Horticultural Experience

Rating	Personal Experience Description	n	Mean Hort Pro-Training Score
1	I've really had no direct personal experiences or outside employment in horticulture. This is a subject area I am personally unfamiliar with.	25	4.0 b[1]
2	I've had very few direct experiences in horticulture. My knowledge and understanding in this subject area is minimal.	67	4.2 ab
3	I've had a few or small number of direct experiences in horticulture. My limited experience has given me some basic knowledge in this subject area, but there is much I don't know or am unfamiliar with.	50	4.3 a
4	I have had a moderate amount of direct private or professional experiences in the area of horticulture. I have a reasonably good grasp on this subject area, but also have room to improve.	12	4.2 ab
5	I have had many direct experiences in the area of horticulture, either privately or professionally, that have helped me become proficient in this subject area.	2	4.5 a

[1]Means within columns identified with the same letter are not significantly different, Ryan-Einot-Gabriel-Welch test, α=0.10.

We combined seven Likert response items from Subsets 2 and 3 (#'s 16, 17, 18, 19, 20, 23 25) into a second measurement scale called "Horticulture Self-Sufficiency" (Table 31). This scale measured CEA-ANR preference and reliance on independent learning and use of existing resources to compensate for lack of competency in the subject of horticulture. The distribution of CEA-ANR responses on this scale are shown in Figure 4.2. Reliability analysis with SPSS gave a Cronbach's alpha of 0.695. I analyzed agent Horticulture Self-Sufficiency scores with analysis of variance to determine if any possible classification factors available in our data influence an agent's agreement or disagreement of being self-sufficient for meeting client demands for horticultural information and problems solving. I found no significant differences in any of our possible classification factors (gender, employment tenure, employment district, client demand for horticulture, etc.). We conclude that agent perceptions measured on this scale are uniformly held across the state and over time, a result of the overarching job duties and common responsibilities of being a CEA-ANR in Texas.

Table 31. *Horticulture Self Sufficiency* Likert Scale

Subset Item #	Statement	Mean[1]	SD
16	Specialist availability and online resources are adequate for me to manage horticultural questions and problems in my county without additional training	3.31	0.97
17	I can increase my ability to manage horticultural questions and problems on my own well enough without additional agency training.	2.78	0.97
18	Specialists and Program Specialists in Extension Horticulture usually know the answer to horticulture questions that I cannot answer.	4.17	0.65
19	Specialists and Program Specialists in Extension Horticulture return phone calls in a timely manner.	3.56	0.84
20	Specialists and Program Specialists in Extension Horticulture reply to Emails in a timely manner	3.67	0.79
23	Online resources (fact sheets and web content) created by AgriLife Extension in the subject area of Horticulture is sufficient for me to help clients in my county.	3.42	0.90
25	I know where to go within AgriLife Extension resources to find information pertaining to Horticulture.	3.55	0.95
	Scale Statistics	3.50	0.47

Note: Cronbach's α=0.695; [1]1=Disagree Strongly, 2-Disagree, 3=Neither Disagree or Agree, 4=Agree, 5=Agree Strongly.

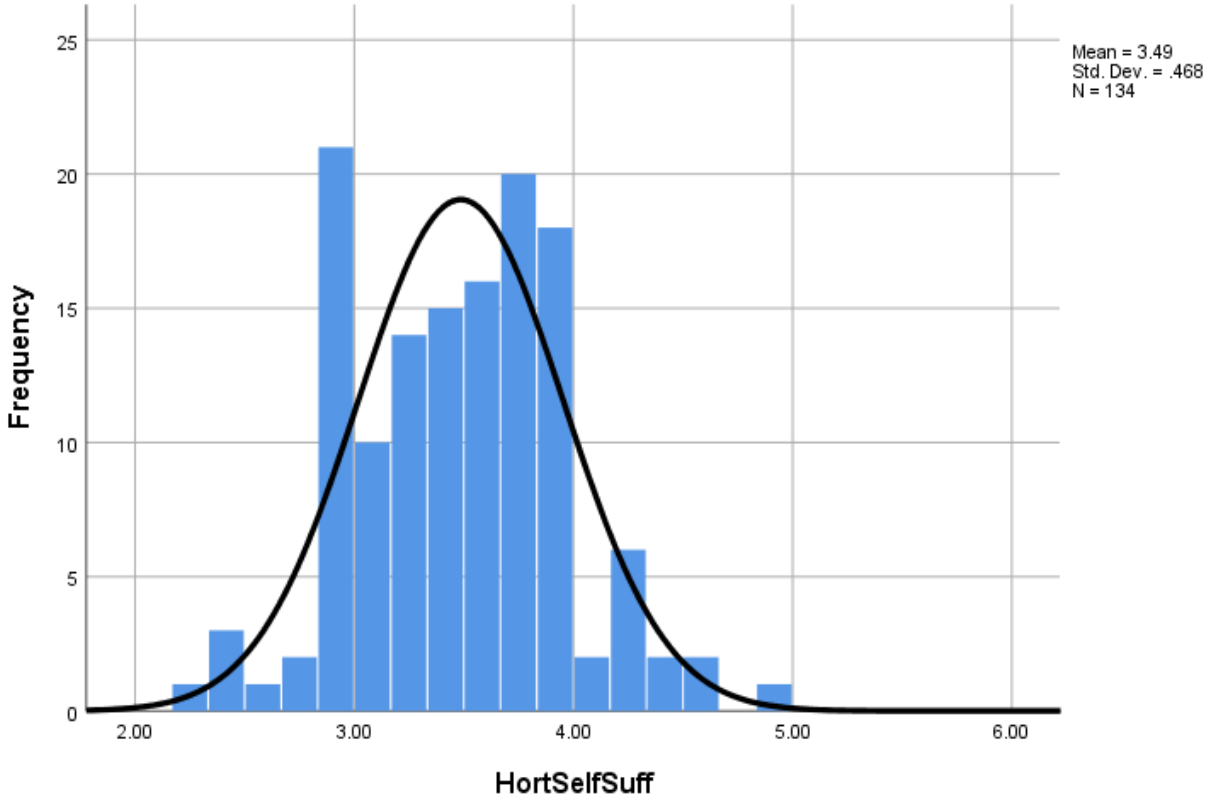

Figure 4.2 CEA-ANR Frequency of Hort Self Sufficiency Scores. 1=Disagree Strongly, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5= Agree Strongly.

Discussion

Employee retention is important to any organization's success. Cooperative Extension agencies are becoming increasingly susceptible to employee turnover from burnout, stress, and other factors (Ensle, 2005). The negative effects of turnover for Extension are unique, because of the hidden costs incurred from lost knowledge, experience, and relationships with local leaders and volunteers (Bradley et al., 2012). The retention problem in Extension could become greater with increased participation of millennials,

who are less sedentary in their early careers (Vines et al., 2018). Extension agencies will need to find ways to retain highly qualified agents to be successful in the future (Cooper & Graham, 2001). Technical subject competency empowers extension professionals to satisfy customers, which then raises the agent (and client) experience by building and fostering positive local relationships (Terry & Israel, 2004). Agency-led technical subject matter professional development facilitates positive relationships between agents and the communities that they serve.by

From results we obtained in our survey of ANR agents, AgriLife Extension has an approximate 40:60 ratio of early career to established career County Extension agents. The early-career component of the county agent population in Texas, being most at risk for separation, should be a focal effort of administrative training strategies. From the ANR agent perspective alone, horticulture should be a priority subject for competency training in many, but not all counties. Agents surveyed in this study revealed that horticulture is moderately to highly important in roughly 80% of Texas counties. Seventy-five percent of ANR agents described a moderate to high increase in demand for horticultural information and problem solving since they started work in their present county of employment.

The main predictor of client demand for horticulture in our study was county population, with 80,000-people population levels being an important level for significant client demand. According to 2019 U.S. Census Bureau data, there are forty-six counties in

Texas with that population level, yet only twenty-four counties in the state staff a CEA-HORT position to focus on county demands for horticultural information and education. Considering the population growth trends in Texas, Extension administration should plan for more CEA-HORT positions. If budgets prevent that, then a strategy of hiring new employees or transferring existing employees with horticultural training into ANR positions in those counties, along with shifting from traditional educational emphases like livestock and row crops could be a stop-gap strategy. County Master Gardener programs are popular in Texas today, and these volunteer programs were perceived as both a benefit to meeting client horticulture demand and a factor in raising the need for greater agent technical competency in horticulture. The suspicion that Master Gardener programs increase visibility and workload for Extension professionals is not new, but proven to be favorably offset by the increased client contacts for horticulture that are possible with a well-trained and motivated Master Gardener program (Grieshop & Rupley, 1984)

The population growth trend in Texas favors increased client demand for horticultural assistance in the future. County population in this study correlated positively with agent perception of county population growth trend. County population also correlated positively with perceptions of client interest in horticulture and the change in that client demand over time. Results from this study show that County Extension agents utilize an array of supportive strategies to deal with the diverse and complex questions that any one agricultural subject area, like horticulture, presents from clientele. Websites, that are

known to serve as a repository of answers, are a critical Extension agent tool for client assistance, as seen in thirty-six percent of agents who listed known websites as their first tactic for answering questions they don't know. Yet the number of participating agents that either disagreed or were uncertain about the sufficiency in quantity of web resources across all agricultural subjects and in horticulture specifically was 46.9% and 44.0%, respectively. An important (36% to 43%) minority of agents were similarly uncertain about or did not know where technical information across agricultural subjects, including horticulture was located. Extension administrative strategy for customer satisfaction, must not only develop web resources for outside clientele, but to serve the needs of their front-line employees as well (Bailey et al., 2014).

Texas County Extension Agents have a high affinity for participating in agency-led professional development programs and a moderate capability for self-sufficiency without training. Hort Pro-Training, a Likert scale, that measures agent association with competency training in general, as well as its need and benefits for raising competency in horticulture had a mean scale score of 4.2 out of 5.0, where 5.0 equals strong agreement. The frequency of agent scores on this scale that were 4.0 or higher was 77.6%. Hort Self-Sufficiency, a Likert scale measuring agent association with independent learning and reliance on supportive resources, had a grand mean score of 3.5, where 5 also equals strong agreement. Frequency of disagreement on Hort Self-Sufficiency was nine percent, and the frequency of scores between 3.0 (undecided) and 4.0 (agree) was 81.3%. We conclude that Texas ANR agents are cautious about

attempting to manage all of the horticulture questions and problems they might encounter going forward with existing resources. Increasing the diversity and accessibility of web resources for agent use is a worthwhile agency investment in employee support and retention efforts (Bailey et al., 2014).

State Cooperative Extension agencies that have county personnel dispersed in high population growth areas should develop strategies for increasing agency competency in horticulture. Although Extension agents today have tremendous availability of internet-based content at their disposal, our study shows that agents still prefer face-to-face learning over distance education, especially where it includes a workshop-style format for experiential learning. Horticulture is a hands-on subject that lends itself to experiential teaching methods. The past personal experiences in horticulture of agents in this study appear to have helped them overcome shortcomings in formal education in the subject. In the same way, Extension administration can develop and provide focused, hands-on competency training programs that greatly improve agent connection to the subject of horticulture and the growing number of people seeking help with it.

5. CONCLUSIONS

Overview of Findings

Horticulture is important in Texas today. The implications of being the second largest land mass state in the U.S. with the highest increases in total population growth and new home construction are that people in Texas will need and seek horticultural information at an increasing rate for the near future. Population growth centers are known to be areas where people seek information on horticultural specialty crops (Lawrence, 1988). We do not fully understand or attempt to explain the predictive relationship between population growth and horticulture interest and demand. Part of the relationship is contained in competitive home values in growing cities that are raised by attractive landscaping (Niemera, 2016). Growing municipalities and urban centers often enact commercial landscaping and tree policies for positive effects on tourism and environmental impact. Increasing amounts of land are devoted to parks, sports fields and other outdoor spaces with horticultural features that must also be maintained. Horticulture can be found at the nexus of increased consumer awareness of the health benefits of fruits and vegetables and the increased consumer and producer interest in locally grown food (Low et al., 2015). Horticulture is also an important leisure activity in America, and population growth will in turn spur an increase in pursuit of that leisure.

Three studies presented in this dissertation contain indicators that Cooperative Extension in Texas is under pressure to deliver horticultural expertise. A majority of early-career

CEA-ANR agents identified horticulture as their most challenging client subject area. Horticulture was also the most-selected training topic that would help them in their county Extension program. Extension horticulture specialists and program specialists in the Texas A&M AgriLife Extension Service (AgriLife Extension) represent some of the most educated, aware and attentive minds to horticulture needs in Texas. Greater than seventy percent (73.6%) of the nineteen specialists I interviewed indicated that demand for their horticultural expertise in Texas had increased since they were hired. An additional 21.1% indicated equal demand. Asked to predict that demand in ten years, 42.1% of horticulture specialists anticipated an increase, and an equal percent predicted similar demand. Two horticultural demand indicators presented in a survey of 158 county ANR agents confirmed an increase in horticulture in some counties of Texas. One third (33.1%) of agent participants rated horticulture as a very important subject, requiring a lot of their time, and 46.6% rated it as equal in importance to other agricultural subjects. A majority of ANR agents (75.8%) perceived a moderate to high increases in the demand for horticultural support from the clientele they serve. We also identified a predictive relationship between horticultural demand and change in demand. Where demand for horticultural information and assistance in Texas is strong right now, it also appears to be increasing over time.

AgriLife Extension employs forty-seven Extension professionals that focus on horticulture, including twenty-three extension specialists/program specialists serving the entire state and twenty-four county horticulture agents. Results from our CEA-ANR

survey show a significant increase in agent perception of client demand at county populations of 80,000 and greater. Census bureau data for 2019 finds forty-eight counties in Texas with population levels over 80,000, meaning that at least twice the county horticulture agent positions compared to current numbers are justified. If funding situations prevent adding additional personnel specifically for horticulture, Extension administration must look to better prepare itself to support horticulture through competency training.

A majority of County Extension agents are conscientious professionals, who generally desire to make a difference in people's lives (Harder et al., 2014). Early-career ANR Extension agents gave the following responses when asked about the importance they place on answering technical client questions themselves: "it's very important; I take it seriously," "it's important to be able to help them," "definitely important--it's our job," "I think it's really important to answer those questions, because they are coming to our office as a source of good information," "It's a break or make deal; it effects their opinion of whether you are trustworthy or not," "It goes a long way with the client," "It's the greatest way for us to establish credibility," and "they will eventually quit coming back if you can't help them; Google may put us out of the County Extension agent business."

In contrast to these motivated statements, our specialist interviews revealed that a majority of ANR agents had lower than satisfactory competency in horticulture, and that

some of those agents exhibited indifference about being engaged in horticulture projects or gaining competency in the subject (data not presented). Training fatigue and job burnout could be obstacles to effective competency training with longer-tenured agents (Ensle, 2005), but our Horticulture Pro-Training measurement scale indicated good agent association with competency training, especially training focused on horticulture. Retaining high quality extension professionals that are the "key to Extension's future" (Cooper & Graham, 2001) can be accomplished by investing in employee's professional development, training, and support that envisions customer satisfaction through the lens of employee satisfaction (Heskett et al., 1994; Terry & Israel, 2004).

Implications for AgriLife Extension

The research findings reported in this dissertation triangulate the need for agency-sponsored competency training in horticulture. Five of eight early-career ANR Extension agents described horticulture as a preferred training subject that would also benefit their work with county clients. Only six percent (6.25%) of Extension horticulture specialists or program specialists rated ANR agent competency in horticulture as *satisfactory*, the remainder rating ANR agents in general as below satisfactory. Seventy-two percent of ANR agents themselves agreed or strongly agreed that additional training in the subject of horticulture would help them as Extension agents. It therefore could benefit AgriLife Extension leadership to consider these needs in future professional development strategies.

Our CEA-ANR survey results revealed that almost one third (32.1%) of ANR agents had no college-level horticulture class prior to becoming a county agent. Nearly sixty percent more (59.6%) had only introductory-type exposure to horticulture in a college setting. Hiring of new agents with little to no horticulture background potentially contributes to agent turnover if a) they are placed into a county with moderate to high horticulture demands and b) if they are not provisioned and supported to manage horticulture questions with training and resources. Twenty percent of ANR agents rated horticulture as not an important subject in their county. Results further indicate that county population levels at and above 80,000 have greater demand for horticultural education and assistance.

Extension administration can help itself better serve client demand for horticultural support in Texas by recruiting new agents who have formal background training in horticulture for those counties where there is high or growing demand. I recommend developing an Extension county horticulture scoring system, using county population and additional indicators from new home construction, municipal beautification policies and horticultural crop production to further rank horticulture demand. County Extension agent hiring or transferring policies should give weight to both formal horticulture training and personal horticulture experience as factors in selecting ANR agents for high horticulture-demand counties. Early-career agents studied in this dissertation research rely upon past family experiences (i.e., farming, 4-H, FFA) in their attempts to survive

and thrive in Extension. Our ANR Extension agent survey revealed that sixteen percent of agents had enough personal experience with horticulture (gardening, family business, childhood experiences, etc.) to be proficient with the subject. Horticulture is a science, profession and hobby, and Extension employee recruiters need to consider people's exposure to all three facets of the discipline when attempting to evaluate their experience.

My interviews with specialists revealed a potential multiplier effect from training county agents (both CEA-ANR and CEA-HORT) in the subject of horticulture. Specialists perceived greater programmatic reach and reduced workload, allowing them to spend more time and effort toward general educational resource development. Since CEA-ANR association with the Horticulture Self-Sufficiency scale in this dissertation was only moderate and affected somewhat by resource availability and organization, it becomes evident that administration should lead the agent-specialist relationship into a feedback loop that helps both groups. The mechanism for that feedback relationship is County Extension agent training. By raising the competency of both ANR and HORT agents through training, specialists ultimately gain more time to develop web resources and educational products that then further help county personnel manage client workload, even reducing client workload by those same web-based educational resources.

Recommendations for Research

Qualitative research methods offer investigators the opportunity to get to know, understand and relate to human subjects. The interviews I conducted with early-career agents in this dissertation were extremely helpful in painting a picture of the life, challenges, expectations, enjoyment and confusion that new county agents face. When hired, they bring individual personalities, skills and training to a particular county that has its own community-centered social dynamics, demographics, politics, economic strengths, resources and agricultural "personality". Through naturalistic inquiry, the qualitative researcher can uncover how the Extension agent's own motivations and perceptions are being affected by the agency's current course and direction, within the context of their county of employment. Problems with the employee, with the county dynamics, and with administration can be uncovered. The self-starting, motivation toward achievement, opportunities, and successes of a County Extension agent can also be uncovered.

Although it takes tremendous devotion of time to conduct person-to-person interviews, AgriLife Extension would gain useful introspection and insight into future professional development needs and strategies by similarly conducting interviews and focus groups with middle and late career county extension agents. Middle career agents would be those with ten to fifteen years of experience, and late career would be those with twenty-five or more years of experience. An assessment of their views, perceptions and attitudes

toward competency, including how and why they target technical areas within which to gain competency would be helpful in crafting organizational development strategies for the next decade. Experienced county agents have tremendous insight to share. They are survivors of a demanding profession, and they represent individual repositories of how to build relationships and networks of support, while also leading educational programs and representing cooperative extension successfully. Their stories and their experiences are important to capture.

Person-to-person interviews and focus groups can also reveal new teamwork and organizational-building opportunities among Extension colleagues. I gained newfound respect and insight into the skills, experiences and collaboration potential of extension horticulture specialists and program specialists by conducting peer interviews for chapter three in this dissertation. The expertise, research, and Extension program areas within the Extension Horticulture Unit of the Texas A&M AgriLife Extension Service are very diverse. Specialists often work individually and independently within their respective programs, so much so that opportunities for collaboration can be lost. Although co-workers in the same workplace typically have congenial relationships, it is also possible for them to not know very much about one another's past experiences or present views, goals, and direction. Administrators should consider strategies that from time to time, challenge co-workers to intentionally learn more about one another professionally, to stimulate team building and greater collaboration.

Horticulture is a diverse field, and external clientele interest in horticulture is both eclectic and ever-changing. In our survey of ANR Extension agents, we presented a question that asked them to rank ten horticulture topics according to their importance for their respective county. That data was not analyzed and presented in this dissertation. Similarly, although specialist interviews elucidated desired agent training approaches and amount of time needed, the actual horticultural topics of importance was not borne out. As future horticulture training programs for agents are conceived, a better understanding of what topics to place priority on for such trainings will be needed. Using the existing ANR agent survey data on priority horticulture subjects as a starting point, Q Methodology could be undertaken with Extension personnel to more rigorously and precisely build the topics of horticulture needed for agent training and future professional development. Q methodology is an idea-sorting exercise wherein the participant, who might be a hort agent or specialist, becomes the response variable by making unique choices to a predetermined list or library of possibilities. It combines elements of quantitative and qualitative research, and has the potential to help Extension personnel understand how people think and prioritize concepts in needs assessment (Lien et al., 2018).

AgriLife Extension has potential to gain additional financial and political support by researching the contribution of horticulture to emotional wellbeing. AgriLife Extension's Horticulture Unit is rightfully and actively engaged in the food production side of horticulture. The interest in small-scale commercial production of fruits and vegetables

as well as popularity of youth and home gardening in Texas justifies continued development and delivery of educational programs and products targeting edible crop production. Commercial nursery production and landscape horticulture are likewise areas of external client demand that need continued program delivery. Our current approach to evaluation of these programs should be expanded to assess the impact of recreational gardening or commercial horticulture production on emotional wellbeing. The receptivity of gardening education during the 2020 Covid-19 Crisis only partially highlights how important horticulture is to people as a therapeutic practice contributing to mental health. When asked to describe how their research and extension programs help Texans better their lives, 32% of specialists interviewed included emotional wellbeing as one means of accomplishing that. Participant 5 made this statement, "I think it helps ground people. It's very grounding. It's very peaceful, grounding and therapeutic, besides providing food and beauty." These overlooked benefits of horticulture, as with the emerging benefits of physical health from consumption of horticultural crops, need to be brought to the attention of Cooperative Extension administration and the legislators of Texas who fund Extension. We must set ourselves up to succeed by asking the right questions as we evaluate Extension educational programs.

Recommendations for Practice

The studies in this dissertation approach the subject of training County Extension agents from the perspective of a traditional, one-to-many lecture format with agents participating as a group, either face-to-face or via distance technology. As revealed in Chapter 4, Extension agents have the highest preference for face-to-face trainings that are agency-sponsored and contain experiential elements in the training schedule. Extension horticulture specialists had very mixed opinions on the length of time needed for such a training. The range in their responses for a single training class that would give agents with no horticulture background a functional level of competency in the subject of horticulture was 122 hours. Those same specialists also recognized financial restrictions, the logistical challenges of aligning agent and specialist calendars, geographic distance, and the competing tasks and demands faced by the agent trainees as obstacles to this overall approach to increasing agent competency. Early-career Extension agents that I interviewed concurred with these specialist-perceived obstacles, most commonly citing “lost office time” and “falling behind with regular duties” as detractions from participating in face-to-face, agency-led training programs. Texas County Extension agents in 2020 lead very busy professional lives that include managing an array of local committee responsibilities, individual client needs, demands by county government personnel, office management and administrative reporting and accountability. Given the importance of providing technical subject matter competency to Texas County Extension Agents in the growing demand area of horticulture, a

challenging question to answer is, “How can training be provided efficiently and cost-effectively?”

Dr. Scott Cummings challenged me to reconcile this dilemma as part of my dissertation preliminary exam, asking me to “develop a new plan for providing subject matter professional development to agents. Develop one strategy for agents less than 5 years of experience and one strategy for those with more than 5 years.” He further stipulated that my proposed plan use technology and “be innovative and very different than what we do today” (Cummings, 2018). My response to Dr. Cumming’s challenge is relevant to this discussion and detailed in these final paragraphs.

Time and distance are training/professional development constraints that are not unique to Extension. Many private businesses face the daunting task of training and developing new and overwhelmed employees dispersed across numerous offices in multiple counties, states or even countries. Gutierrez (2016) provided four strategies for training *overwhelmed* employees including: 1) spacing out classes or training modules in time to allow for assimilation, practice and mental rest; 2) making online training modules easy to locate and search; 3) providing flexible and self-directed learning tracks; and 4) allowing for personalized learning that accounts for skills and abilities of the individual learner.

Based on the number of county extension agents employed by AgriLife Extension, their geographic distribution across the state of Texas, and the collective demands on their

schedules, it is not feasible or affordable to train large numbers of agents face-to-face on an ongoing basis. A portion of any subject matter training program by necessity therefore must be asynchronous, which can be facilitated by computer-based technology. Yet distance training, especially that which is recorded and self-paced, was the least preferred of four methods presented on our CEA-ANR survey.

The appropriate compromise for future development strategies for the agency may be to take a blended approach, integrating technology with in-person training events that maximize time, but don't also suppress learning styles that are fostered by person-to-person interaction (Tolan, 2017). To prepare County Extension agents in Texas for continued growth in demand for horticultural information, recommendations and problem solving that is expected to accompany continued population growth and urbanization in the foreseeable future, I recommend an integrated program that blends face-to-face learning tracks, customizable for an individual agent, with a supportive and dynamic online component.

More specifically, I recommend creation of two, new, certificate-backed, incentive-based training tracks; one for "early career agents" (less than five years tenure), called *HortSavvy*, and one for "established career agents" (more than five years tenure), called *HortExcel*. Both tracks would require agent participation in important horticultural educational events in the state (i.e., Texas Master Gardener Conference, Texas Nursery and Landscape Trade Show, etc.), and implementation of a set of guided outcome programs designed to deliver short-term educational outcomes and long-term impacts for

external clientele. Individual county results from these programs could be aggregated at the district, region or state level for comprehensive summary impacts. Agents participating in the two educational tracks could be further supported by initiating *HortTrain Mobile*, a mobile-ready, tablet-compatible web portal that delivers both traditional web seminars and micro-training videos (3-5 minutes) that allow for customized, efficient, and self-directed learning on an ongoing basis.

I envision HortSavvy and HortExcel as professional development programs that can unify, simplify and incentivize the process of increasing subject matter competency in horticulture among Texas CEA-ANR. Each program represents a different level of training and experience in the discipline of horticulture. HortSavvy would be designed for agents with less than five years tenure or more than five year's tenure with no past participation in the program. We would test participants online to identify subject areas for improvement through online training videos housed in HortTrain Mobile. Once having completed the online training track, participants obtain credit toward fulfillment of their HortSAVVY certification by participating in eight Texas A&M AgriLife programs over three years (or less). These programs include the following annual events: *Texas Nursery & Landscape Association Conference & Trade Show, Texas State Master Gardener Conference, Texas Fruit Conference, Master Gardener Specialist Training-Plant Propagation, Master Gardener Specialist Training-Vegetables, Grape Camp, Texas Pecan Short Course, Extension Horticulture Retreat, and the Texas Plant Protection Conference.* A third requirement for HortSavvy certification is conducting

four horticultural education programs over three years. Four program options are provided, which have planned outcome evaluations, including: *Earth-Kind Turf & Water Management*, *Earth-Kind Landscape & Community Enrichment*, *Small Acreage Crop Starter*, and *Backyard Basic Foods—Fruit & Vegetables*. Upon completion of all three requirements of the program, HortSavvy participants would be asked to demonstrate competency in horticulture through an online exam, and then be awarded a certificate that would offer merit on promotion dossiers.

HortExcel would be designed for those agents with five or more years of experience and who have previously completed the HortSavvy certificate. Potential participants must also test out of or complete all available trainings on HortTrain Mobile. To achieve HortExcel certification, agents must attend two of the following events per year for three consecutive years: *Texas Nursery & Landscape Association Conference & Trade Show, Texas State Master Gardener Conference, Texas Wine & Grape Growers Conference, Texas Fruit Conference, Texas Pecan Short Course, Extension Horticulture Retreat*, or other out-of-state events approved by the agent's regional program leader.

HortExcel participants must host, monitor and evaluate at least one of three long-term outcome programs, aimed at evaluating economic impact, behavioral change, environmental benefit and/or health and wellness during and beyond the offering of the program to county clientele. These long-term programs include: *Landscape Resource Stewards,* a program providing education on strategic plant selection, sustainable

nutrient and pest management, and water conservation; *Sustainable Local Food Producers,* aimed at increasing the food production capacity of families by providing education on small plot, backyard and small acreage growing of herbs, perennial fruits and annual vegetables; and *Youth Gardening & Nutrition*, that develops a youth gardening co-hort with education on basiwikc gardening and human nutrition. Each of these three program options would be supported by Extension subject matter specialists with demonstration materials, videos, experiential learning modules and evaluation instruments. The programs are designed to be integrated, step-wise, multi-session experiential programs conducted over three years, with evaluations conducted annually over the three-year period and up to three years following the conclusion of the program. As with the HortSavvy program, HortExcel participants would also take a horticulture competency exam after completion of their requirements to receive their certificate and dossier inclusion on promotion packets.

HortTrain Mobile is envisioned as a comprehensive, E-learning portal that can facilitate individualized education. It will house short videos that provide easy-to-learn snippets of timely horticultural information, facts, problems and news. HortTrain Mobile is critical to the long-term success of increasing the competency of Texas County Extension Agents in the subject of horticulture. While distance/digital education may not be a preferred educational method of agents themselves, the flexibility of the training program, and ability to integrate it more seamlessly into their busy lives is valuable and necessary.

REFERENCES

Allen, D. G. (2006). Do organizational socialization tactics influence newcomer embeddedness and turnover? *Journal of Management*, *32*(19). https://doi:10.1177/0149206305280103

Bailey, N., Hill, A., & Arnold, S. (2014). Information-seeking practices of county extension agents. *Journal of Extension, 52*(3), Article v52-3rb1. Available at https://www.joe.org/joe/2014june/rb1.php

Bailey, S. J., & Deen, M. K. (2007). 4-H Youth development apprenticeship program: A pilot of a new certification in youth development. *Journal of Extension*, *45*(6), Article 6FEA2. Available at https://www.joe.org/joe/2007december/a2.php

Baker, L. M., & Hadley, G. (2014). The new agent: A qualitative study to strategically adapt new agent professional development. *Journal of Extension, 52*(5), Article v52-5a3. Available at https://www.joe.org/joe/2014october/a3.php

Bartholomew, H. M. & Smith, K. L. 1990. Stresses of multi-county agent positions. *Journal of Extension, 28*(4), Article 4FA2. Available at http://joe.org/joe/1990winter/a2.php

Bradley, L., Driscoll, E., & Bardon, R. (2012). Removing the tension from extension. *Journal of Extension, 50*(2), Article Available at https://www.joe.org/joe/2012april/tt1.php

Brashier, M., Souvestre, R., & Schmit, R. (2006). *2006 LSU Ag Center Annual Report: Louisiana Master Gardener Extension Volunteer Program*. Retrieved from http://www.lsuagcenter.com/topics/lawn_garden/master_gardener/lmg_program_accomplishments/2006-annual-report

Brodeur, C. W., Higgens, C., Galindo-Gonzales, S., Craig, D. D., & Haile, T. (2011). Designing a competency-based new county extension personnel training program: A novel approach. *Journal of Extension, 49*(3), Article v49-3A2. Available at https://www.joe.org/joe/2011june/a2.php

Campbell, C. E. (1968). *Oklahoma's county commissioners' attitudes toward the use of area specialized agricultural extension agents* [Doctoral Dissertation, Oklahoma State University]. https://shareok.org/bitstream/handle/11244/30309/Thesis-1968D-C187o.pdf?sequence=1

Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). John Wiley & Sons.

Connors, J., J. (2012). Liberty Hyde Bailey: Agricultural educator and philosopher. *North American Colleges and Teachers of Agriculture Journal*, *56*(4), 7. https://www.nactateachers.org/index.php/vol-56-num-4-dec-2012/2014-liberty-hyde-bailey-agricultural-educator-and-philosopher

Cooper, A. W., & Graham, D. L. (2001). Competencies needed to be successful county agents and county supervisors. *Journal of Extension*, *39*(1), Article 1RIB3. Available at https://www.joe.org/joe/2001february/rb3.php

Cummings, S. R. (2018). [Personal communication]. PhD preliminary exam.

Demuro, K. (2013). The many benefits of community gardens. Retrieved from https://greenleafcommunities.org/the-many-benefits-of-community-gardens/

Elliott, A. J., & Dweck, C. S. (2005). Competence as the core of achievement motivation. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (1st ed.). Guilford Press.

Ensle, K. M. (2005). Burnout: How does Extension balance job and family? *Journal of Extension*, *43*(3), Article 3FEA5. Available at https://www.joe.org/joe/2005june/a5.php

Extension Master Gardener Program. (2020). *Extension Master Gardener-People, plants, and partnerships*. https://mastergardener.extension.org/

Fehlis, C. (1992). Urban Extension programs. *Journal of Extension*, *29*(2), Article 2FEA3. Available at https://www.joe.org/joe/1992summer/a3.php

Food and Agriculture Organization of the United Nations. (2020). *FAOSTAT*. http://www.fao.org/faostat/en/#data/QC

Fry, J. (2020). [Personal Communication]

Fusonie, A. (2020). *Prince Family Manuscript Collection*. National Agricultural Library Retrieved from https://specialcollections.nal.usda.gov/guide-collections/prince-family-manuscript-collection

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction* (6th ed.). Pearson.

Garst, B. A., Hunnings, J. R., Jamison, K., Hairston, J., & Meadows, R. R. (2007). Development of a comprehensive new 4-H Extension agents training program using a multi-module approach and the 4-H professional, research, knowledge

and competencies (4HPRKC) taxonomy. *Journal of Extension*, *45*(1), Article 1FEA3. Available at https://www.joe.org/joe/2007february/a3.php

Greiner, A. C., & Knebel, E. (2003). The core competencies needed for health care professionals. In A. C. Greiner & E. Knebel (Eds.), *Health professions education: A bridge to quality*. National Academies Press US.

Grieshop, J. I., & Rupley, V. (1984). How do you spell relief? Master gardening! *Journal of Extension*, *22*(4), 4FEA3. Available at https://www.joe.org/joe/1984july/a3.php

Gutierrez, K. (2016). *Four ways to train the overwhelmed employee*. Shift-Disruptive ELearnin. https://www.shiftelearning.com/blog/overwhelmed-employee-training

Hall, C., & Dickson, M. W. (2011). Economic, environmental, and health/well-being benefits associated with green industry products and services: A review. *Journal of Environmental Horticulture. 29*, 96-103. https://doi.org/10.24266/0738-2898-29.2.96

Hall, C. V. (2020). *History of Iowa State Horticulture Department*. Iowa State University Horticulture Department. Retrieved June 13, 2020 from https://www.hort.iastate.edu/about-us/history/

Harder, A., Gouldethorpe, J., & Goodwin, J. (2014). Why work for Extension? An examination of job satisfaction and motivation in a statewide employee retention study. *Journal of Extension*, *52*(3), Article 3FEA5. Available at https://joe.org/joe/2014june/pdf/JOE_v52_3a5.pdf

Harter, S. (1978). Effectance motivation reconsidered toward a developmental model. *Human Development*, *21*(1), 34-64.

Healy, W. (1991). Horticulture Extension trends in an urban state. *Journal of Extension*, *29*(2), Article 2RIB5. Available at https://www.joe.org/joe/1991summer/rb5.php

Heskett, J. L., Jones, T. O., Loveman, G., Sasser, W. E. J., & Schlesinger, L. A. (1994). Putting the service-profit chain to work. *Harvard Business Review*, (*March-April*).

Heskett, J. L., Sasser, W. E., & Schlesinger, L. A. (1997). *The service profit chain: how leading companies link profit and growth to loyalty, satisfaction, and value*. Free Press. https://books.google.com/books?id=u_G2AAAAIAAJ

Higher-Ed.org. (2020). An explanation of the first Morrill Act. Higher-ed.org. http://www.higher-ed.org/resources/morrill1.htm

Higher-Ed.org. (2020). *The Smith-Lever Act of 1914 established the cooperative extension service*. http://www.higher-ed.org/resources/smith.htm

Hodges, A. W., Hall, C. R., Palma, M. A., & Khachatryan, H. (2015). Economic contributions of the green industry in the United States in 2013. *HortTechnology*, *25*(6). https://doi.org/https://doi.org/10.21273/HORTTECH.25.6.805

Hutchins, G. K. (1992). Evaluating County Clustering. *Journal of Extension*, *30*(1), Article 1FEA5. Available at https://www.joe.org/joe/1992spring/a5.php

Janick, J. (2007). The origin of horticultural technology and science. *Acta Horticulturae*, *749*, 41-60. https://hort.purdue.edu/newcrop/originhorttech.pdf

Janick, J. (2008). The founding and founders of the Royal Horticultural Society. *Chronica Horticulturae*, *48*(1), 17-19. https://www.hort.purdue.edu/newcrop/pdfs/ch4801p17.pdf

Janick, J., & Goldman, I. L. (2003). Horticulture, horticultural science, and 100 years of ASHS. *HortScience*, *38*(5), 17.

Knapp, B. (1920). *Marketing and purchasing demonstrations in the South*. Washington Government Printing Office Retrieved from https://books.google.com/books?id=DTQeAQAAIAAJ&pg=PA217&lpg=PA217&dq=first+texas+county+horticulture+agent&source=bl&ots=deAxJ5Ha50&sig=ACfU3U1xnD_pqQxbReUwK3dR0n5X_tiUKg&hl=en&sa=X&ved=2ahUKEwj1_-GNxobqAhV6SDABHVEpC7Q4ChDoATAJegQIChAB#v=onepage&q=first%20texas%20county%20horticulture%20agent&f=false

Kutilek, L. M., Conklin, N. L., & Gunderson, G. (2002). Investing in the future: Addressing work/life issues of employees. *Journal of Extension*, *40*(1), Article 1FEA6. Available at https://www.joe.org/joe/2002february/a6.php

Kyle, R. A., & Shampo, M. A. (2001). Justus von Liebig--Leading teacher of organic chemistry. *Mayo Clinic Proceedings*, *76*, 921-922. https://www.mayoclinicproceedings.org/article/S0025-6196(11)62112-5/pdf

Lauby, K. (2006). Do public gardens matter? *Public Garden: the Journal of the Amer. Soc. Botanical Gardens and Arboreta, (21)*1.

Lawrence, H. W. (1988). Changes in agricultural production in metropolitan areas. *Professional Geographer XL, 1988*(May), 16.

Leadership Advisory Council, National Association of State Universities and Land-Grant Colleges. 2005. *Extension Committee on Organization and Policy, 2005 Report*. https://files.eric.ed.gov/fulltext/ED508419.pdf

Leuchtman, P. (2019). Between the rows: A founding father's love of horticulture. https://www.recorder.com/Between-the-Rows-A-founding-father-s-love-of-horticulture-24595032

Lien, A. M., Ruyle, G., & Lopez-Hoffman, L. (2018). Q Methodology: A method for understanding complex viewpoints in communities served by extension. *Journal of Extension*, *56*(2), Article V56-2IW4.Available at https://joe.org/joe/2018april/iw4.php

Lindner, J. R., Murphey, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, *42*(4), 11. Available at http://www.jae-online.org/attachments/article/387/42-04-43.pdf

Lineberger, R. D. (2020). *Horticulture: The land-grant legacy in the Lone Star State*. Texas A&M University Department of Horticultural Sciences. https://hortsciences.tamu.edu/history/texas-horticulture-milestones/

Low, S. A., Adalja, A., Beaulieu, E., Key, N., Martinez, S., Melton, A., Perez, A., Ralston, K., Stewart, H., Suttles, S., Vogel, S., & Jabloski, B. B. R. (2015). Trends in U.S. Local and Regional Food Systems, Report to Congress. USDA ERS Bull. AP-068. https://www.ers.usda.gov/webdocs/publications/42805/51173_ap068.pdf

Marr, C. (2013). A history of the horticulture department at Kansas State University, 1870-2012. Kansas State University Pamphlet. Retrieved from https://hnr.k-state.edu/doc/department-information/HistoryHorticurltureDeptKSU.pdf

May, I. M. J. (2010). *Texas Agricultural Extension Service*. Texas State Historical Association. Retrieved 6/15/2020 from https://tshaonline.org/handbook/online/articles/amtpw#:~:text=Section%20107.,%2C%20on%20May%208%2C%201914

Meyer, M. H., Needham, D., Dole, J., Trader, B., Fox, J., Conley, M., Neff, M., & Shaw, J. (2016). Importance of horticulture and perception as a career. *HortTechnology*, *26*(2), 7. https://doi.org/https://doi.org/10.21273/HORTTECH.26.2.114

Miko, I. (2008). Gregor Mendel and the principles of inheritance. *Nature Education*, *1*(1), 134. https://www.nature.com/scitable/topicpage/gregor-mendel-and-the-principles-of-inheritance-593/

Minor, D. (2010). *Knapp, Seaman Asahel*. Texas State Historical Association. Retrieved June 15, 2020 from https://tshaonline.org/handbook/online/articles/fkn02

Moore, G. E. (2019). *Victory Gardens*. National Association of Agricultural Educators. Retrieved 6/16/2020 from https://communities.naae.org/docs/DOC-28144-victory-gardens

The National Schools of Science. (1867). *The Nation*, *5*(125), 2. Retrieved from https://books.google.com/books?id=Mf0xAQAAIAAJ&dq

Niemera, A. (2016, October 3, 2016). How Much does landscaping really add to a home's value? *Turf Magazine-online*. https://www.turfmagazine.com/services/landscaping-actual-home-value/

Office of the Governor, Texas Budget Division and the Legislative Budget Board. (2018). *Legislative appropriations; request for fiscal years 2020 and 2021*. Retrieved from http://www.thecb.state.tx.us/DocID/pdf/11386.pdf

Organizational Development Unit, Texas A&M AgriLife Extension Service. (2017). *Organizational Development.* http://agrilife.org/od/employee-development/

Palma, M. A., & Hall, C. (2016). *Economic contributions of the green industry to the Texas economy*. Report to the Texas Nursery and Landscape Association, Retrieved from http://www.tnlaonline.org/uploads/7/7/5/3/77532106/15_economic_impact_of_the_green_industry_in_texas.pdf

Palma, M. A., & Hall, C. (2019). *Economic contributions of the green industry to the Texas economy*. Report to the Texas Nursery and Landscape Association, Retrieved from http://www.tnlaonline.org/uploads/7/7/5/3/77532106/18_economic_impact_of_the_green_industry_in_texas.pdf

Perry, L. (2002). *Famous Persons in Horticulture, D-F*. University of Vermont Extension. Retrieved from http://pss.uvm.edu/ppp/articles/famousDF.html

Radhakrishna, R. B., & Thomson, J. S. (1996). Extension agents' use of information sources. *Journal of Extension*, *34*(1), Article 1RIB2. Available at https://www.joe.org/joe/1996february/rb2.php

Rockwell, S. K., Furgason, J., Jacobson, C., Schmidt, D., & Tooker, L. (1993). From single to multicounty programming units. *Journal of Extension*, *31*(3), Article 3FEA4. https://www.joe.org/joe/1993fall/a4.php

Rubatzky, V. E., & Yamaguchi, M. (2012). *World vegetables: Principles production and nutritive values,* (2nd ed.). Springer.

Schaub, I. O. (1914). *The 4-H Victory Garden*. Retrieved from https://communities.naae.org/external-link.jspa?url=https%3A%2F%2Fd.lib.ncsu.edu%2Fcollections%2Fcatalog%2Fgng00180%23%3Fc%3D0%26m%3D0%26s%3D0%26cv%3D0%26z%3D847.3995%252C4201.9582%252C3708.1402%252C1820.2778

Schlup, L. A. (1939). *Extension Service Review*. Washington, DC: USDA Retrieved from https://books.google.com/books?id=2EzmAAAAMAAJ&pg=RA2-PA110&lpg=RA2-PA110&dq=first+county+home+economics+agent+in+Texas&source=bl&ots=LKax9_CaPT&sig=ACfU3U1jKyjKELKnxmJLd3YoS-9n2lKIbQ&hl=en&sa=X&ved=2ahUKEwiLlt2LzIbqAhWWPM0KHab2C-wQ6AEwAnoECAYQAQ#v=onepage&q=first%20county%20home%20economics%20agent%20in%20Texas&f=false

Seevers, B. S., & Foster, B. B. (2004). A profile of female county agricultural agents in today's CES. *Journal of Extension*, *42*(6), Article 6FEA3, https://www.joe.org/joe/2004december/a3.php

Shackelford, P. (2016). [Personal Communication].

Shih, W., & Evans, J. F. (1991). Where field staff get information. *Journal of Extension*, *29*(3).

Stearn, W. T. (1976). Carl Linnaeus and the theory and practice of horticulture. *Taxon*, *25*(1), 11.

Stone, B., & Coppernoll, S. (2004). You, Extension and success: A competency-based professional development system. *Journal of Extension*, *42*(2), Article 2IAW1. Available at https://www.joe.org/joe/2004april/iw1.php

Stone, B. B., & Bieber, S. (1997). Competencies: A new language for our work. *Journal of Extension*, *35*(1), Article 1com1 https://www.joe.org/joe/1997february/comm1.php

Terry, B. D., & Israel, G. D. (2004). Agent performance and customer satisfaction. *Journal of Extension*, *42*(6), Article 6FEA4. Available at https://www.joe.org/joe/2004december/a4.php

Texas A&M AgriLIfe Extension Service. (2017). Compact with Texans-Mission. http://agrilifeextension.tamu.edu/about/legal-information/compact-texans/

Texas A&M AgriLife Extension Service. (2020). *Who we are: Agency overview*. Retrieved from https://agrilifeextension.tamu.edu/about/who-we-are/

The Association of International Certified Professional Accountants. (2020). *Certified Public Accountant (CPA)*. Retrieved June 16, 2020, from https://www.aicpa-cima.com/designations-certifications/certified-public-accountant-cpa.html

The Pennsylvania State University. (2009). *Department of Horticulture Strategic Plan*, https://plantscience.psu.edu/about/strategic-plan

Tolan, J. (2017). *New tools are changing the way employees learn on the job and are improving the process for both employees and employers*. https://www.business.com/articles/4-ways-technology-is-changing-on-the-job-training/

University of Tennessee Institute of Agriculture. (2020). *Public horticuture--What is public horticulture?* https://ag.tennessee.edu/herbert/Pages/publichort.aspx

Ursachi, G., Horodnic, I. A., & Zait, A. (2015). How reliable are measurement scales? External factors with influence on reliability estimators [7th International Conference on Globalization and Higher Education in Economics and Business Administration]. *Procedia Economics and Finance*, *20*, 7.

U.S. Census Bureau. (2019a). *Building Permits Survey*. Retrieved from https://www.census.gov/construction/bps/stateannual.html

U.S. Census Bureau. (2019b). *State population totals: 2010-2019*. Retrieved from https://www.census.gov/data/datasets/time-series/demo/popest/2010s-state-total.html

USDA-Natl. Agriculture Statistics Service. (2017). *Census of Agriculture State-Level Data*. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_US_State_Level/

USDA-Natl. Inst. of Food & Agriculture. (2017). *Land-Grant University Website Directory*. Retrieved from https://nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory

USDA-Natl. Inst. of Food & Agriculture. (2020a). *1890 Land-Grant Institutions Programs*. Retrieved from https://nifa.usda.gov/program/1890-land-grant-institutions-programs

USDA- Natl. Inst. of Food & Agriculture. (2020b). *NIFA Tribal Programs*. Retrieved from https://nifa.usda.gov/program/nifa-tribal-programs

USDA- Natl. Inst. of Food & Agriculture. (2020c) *USDA Definition of Specialty Crop*. Retrieved from https://nifa.usda.gov/sites/default/files/resources/definition_of_specialty_crops.pdf

Vines, K. A., Cletzer, D. A., Westfall-Rudd, D., Lambur, M., Hunnings, J. R., & Vines, N. T. (2018). Identifying needs and implementing organizational change to improve retention of early-career agents. *Journal of Extension*, *56*(1), Article V56-1A2. Available at https://joe.org/joe/2018february/a2.php

Von Baeyer, E. (2010). *The Development and History of Horticulture*. https://books.google.com/books?id=8gdKjwEACAAJ

West, B. C., Drake, D., & Londo, A. (2009). Extension: A modern-day Pony Express? *Journal of Extension*, *47*(2), Article v47-2comm1. Available at https://www.joe.org/joe/2009april/comm1.php

White, R. (1959). Motivation reconsidered. The concept of competence. *Psychology Review*, *66*, 26.

Young, J. A., Stone, J., Aliaga, A., & Shuck, B. (2013). Job embeddedness theory: Can it help explain employee retention among Extension agents? *Journal of Extension*, *51*(4), Article v51-4A7.Available at https://joe.org/joe/2013august/a7.php

APPENDIX A.

STATEMENT OF PURPOSE AND WORK INSTITUTED BY THE SMITH-LEVER ACT OF 1914.

Sec. 1	In order to aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture, home economics, and rural energy, and to encourage the application same, there may be continued or inaugurated in connection with the college or the colleges in each State, Territory, or possession, now receiving, or which may hereafter receive, the benefits of the Act of Congress approved July second, eighteen hundred and sixty-two, entitled "An Act donating public lands to several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," and of the Act of Congress approved August thirtieth, eighteen hundred and ninety, agricultural extension work which shall be carried on in cooperation with the United States Department of Agriculture: Provided, That in any State, Territory, or possession in which two or more such colleges have been or hereafter may be established, the appropriations hereinafter made to such State, Territory, or possession shall be administered by such college or colleges as the legislature of such State, Territory, or possession may direct.
Sec. 2	Cooperative agricultural extension work shall consist of the development of practical applications of research knowledge and giving of instruction and practical demonstrations of existing or improved practices or technologies in agriculture, home economics, and rural energy, and subjects relating thereto to persons not

	attending or resident in said colleges in the several communities, and imparting information on said subjects through demonstrations, publications, and otherwise and for the necessary printing and distribution of information in connection with the foregoing; and this work shall be carried on in such manner as may be mutually agreed upon by the Secretary of Agriculture and the State agricultural college or colleges or Territory or possession receiving the benefits of this Act.
Sec. 3	here are hereby authorized to be appropriated for the purposes of this Act such sums as Congress may from time to time determine to be necessary. (b)(1) Out of such sums, each State and the Federal Extension Service shall be entitled to receive annually a sum of money equal to the sums available from the Federal cooperative extension funds for the fiscal year 1962, and subject to the same requirements as to furnishing of equivalent sums by the State, except that amount heretofore made available to the Secretary for allotment on the basis of special needs shall continue available for use on the same basis. (b)(2) There is authorized to be appropriated for the fiscal year ending June 30, 1971, and for each fiscal year thereafter, for payment to the Virgin Islands, Guam, and the Northern Mariana Islands, $100,000 each, which sums shall be in addition to the sums appropriated for the several States of the United States and Puerto Rico under the provisions of this section. The amount paid by the Federal Government to the Virgin Islands and Guam pursuant to this paragraph shall not exceed during any fiscal year, except the fiscal years ending June 30, 1971, and June 30, 1972,

		when such amount may be used to pay the total cost of providing services pursuant to this Act, the amount available and budgeted for expenditure by the Virgin Islands and Guam for the purposes of this Act. (c) Any sums made available by the Congress for further development of cooperative extension work in addition to those referred to in subsection (b) hereof shall be distributed as follows: 1. Four per centum of the sum so appropriated for each fiscal year shall be allotted to the Federal Extension Service for administrative, technical, and other services, and for coordinating the extension work of the Department and the several States, Territories, and possessions. 2. Of the remainder so appropriated for each fiscal year 20 per centum shall be paid to the several States in equal proportions, 40 per centum shall be paid to the several States in the proportion that the rural population of each bears to the total rural population of the States as determined by the census, and the balance shall be paid to the several States in the proportion that the farm population of each bears to the total farm population of the several States ad determined by the census: Provided, That payments out of the additional appropriations for further development of extension work authorized herein may be made subject to the making available of such sums of public funds by the States from non- Federal funds for the maintenance of cooperative agricultural extension work provided for in this

		Act, as may be provided by the Congress at the time such additional appropriations are made: Provided further, That any appropriation made hereunder shall be allotted in the first and succeeding years on the basis of the decennial census current at the time such appropriation is first made, and as to any increase, on the basis of decennial census current at the time such increase is first appropriated. (d) The Federal Extension Service shall receive such additional amounts as Congress shall determine for administration, technical, and other services and for coordinating the extension work of the Department and the several States, Territories, and possessions. (e) Insofar as the provisions of subsections (b) and (c) of this section, which require or permit Congress to require matching of Federal Funds, apply to the Virgin Islands of the United States and Guam, such provisions shall be deemed to have been satisfied, for the fiscal years ending September 30, 1978, and September 30, 1979, only, if the amounts budgeted and available for expenditure by the Virgin Islands of the United States and Guam in such years equal the amounts budgeted and available for expenditure by the Virgin Islands of the United States and Guam in the fiscal year ending September 30, 1977. (f)(1) The Secretary of Agriculture may conduct educational, instructional, demonstration, and publication distribution programs through the Federal Extension Service and enter into cooperative agreements with private nonprofit and profit organizations and individuals

		to share the cost of such programs through contributions from private sources as provided in this subsection. (f)(2) The Secretary may receive contributions under this subsection from private sources for the purposes described in paragraph (1) and provide matching funds in an amount not greater than 50 percent of such contributions.

APPENDIX B.

TEXAS HORTICULTURE COMPETENCY SURVEY INSTRUMENT

Q1: Consent Statement

- ○ Yes, I consent to participation in this Texas A&M AgriLife Extension survey. (1)
- ○ No, I do not wish to participate in this Texas A&M AgriLife Extension survey (2)

Q2: Job title verification

Q3 Which administrative district is the county that you work in located?

Q4 County population estimate:

Q5 Which answer below describes the present population growth or decline in the county you work in?

- ○ Declining population. (1)
- ○ Static/stable population--no perceptible change. (2)
- ○ Slow growing population. (3)
- ○ Moderately growing population. (4)
- ○ Rapidly growing population. (5)

Q6 Please write in the number of years (to the nearest half year) that you have been employed by AgriLife Extension in this county?

Examples: "4.5", "8", "16.5" (Do not include any years of experience in other county positions).

Q7 What is your total (collective) years of experience (to the nearest half year) as an Extension Agent (including your tenure in the present position)? Examples: "4.5", "8", "14.5".

Q8 Please choose from the following choices to describe your career experience as a County Extension Agent:

- ○ All of my years of experience as an Extension Agent are in Texas. (1)
- ○ Some of my past experience as an Extension Agent includes employment in other state Extension systems. (2)

Q9 You are: Male (1) Female (2)

Q10: Agent Perceptions—Subset 1 Please rate your level of disagreement or agreement with the following eleven statements:

	Disagree Strongly (1)	Disagree (2)	Neither Disagree or Agree (3)	Agree (4)	Agree Strongly (5)
Being able to answer questions across a range of agricultural disciplines contributes positively to a county extension agent being successful. (2)	○	○	○	○	○
County agents should be expected to be competent in all agricultural disciplines when they begin their careers. (1)	○	○	○	○	○
It is important for county extension agents to be competent in the priority subjects in their county. (10)	○	○	○	○	○
It is not reasonable to expect county agents to be competent in all agricultural subjects. (6)	○	○	○	○	○

County agents can gain competency in subjects that they were not previously trained in by learning on the job. (3)	○	○	○	○	○
Organized agency-training events are beneficial for agents to gain technical subject matter competency. (4)	○	○	○	○	○
Organized agent training efforts are beneficial and a high priority for me to participate in. (7)	○	○	○	○	○
Organized agent training efforts are difficult for me, because they compete for my time needed to do other job-associated tasks. (8)	○	○	○	○	○
Organized agent training efforts are difficult for me, because of costs associated with traveling to such events. (9)	○	○	○	○	○

Texas A&M Agrilife Extension should develop more organized training events specifically for agent technical subject matter competency. (5)	○	○	○	○	○
Texas A&M AgriLife Extension presently requires too much agent time for technical subject matter competency training. (18)	○	○	○	○	○

Q11. Agent Training Experience

For each type of the 9 professional development training event shown below, please select the choice that describes your level of past participation.

	Select one choice to describe your past participation.			
	0 (never) (1)	1 to 10 times (2)	11 to 20 times (3)	21 or more times (4)

In person (face-to-face) training conducted specifically for county extension agents within my district. (1)	○	○	○	○
In person (face-to-face) training conducted specifically for county extension agents outside my district, but within Texas. (2)	○	○	○	○
In-person (face-to-face) event conducted for growers/producers/anyone (example: Beef Cattle Shortcourse). (7)	○	○	○	○
Distance-taught (live) event (webinar) specifically for agents conducted by AgriLife Extension. (3)	○	○	○	○
Distance-taught (live) event (webinar) specifically for agents conducted by some other agency, institution or private entity. (4)	○	○	○	○

Distance-taught (live) event (webinar) conducted for growers/producers/anyone. (8)	○	○	○	○
Distance-taught (recorded) event specifically for agents, produced by AgriLife Extension. (5)	○	○	○	○
Distance-taught (recorded) event specifically for agents, produced by some other agency, institution or private entity. (6)	○	○	○	○
Distance-taught (recorded) event (webinar) produced for growers/producers/anyone. (9)	○	○	○	○

Q12 Agent Training Preference Please rate your personal level of enjoyment and perceived educational effectiveness for each of the four listed type of training activity.

	Dislike Strongly; I don't learn well in this type of training (1)	Dislike Somewhat; I learn better in other types of trainings. (2)	Neither like or dislike. (3)	Like Somewhat. I learn OK in this type of training. (4)	Like a Lot (Preferred); I learn best in this type of training. (5)
In-person (face-to-face) lecture/seminar with slides and other visual aids. (1)	○	○	○	○	○
In-person (face-to-face) workshop with some experiential learning features (field/equipment demonstrations, hands-on activities). (2)	○	○	○	○	○

Distance-taught (live) webinar with participants listening/watching a lecture with visual aids (ppt) and the ability to interact with presenter(s). (3)	○	○	○	○	○
Distance-taught (recorded) webinar that participants can watch on their own schedule. (4)	○	○	○	○	○

Q13. Please select the choice that describes your college-level training in the area of horticulture:

- ○ I took no horticulture classes in college and have no major or minor degree in horticulture. (1)
- ○ I took at least one or a few horticulture classes, but hold no major or minor degree in horticulture. (2)
- ○ Although I hold no degree in horticulture, I took enough horticulture classes to be considered a minor degree. (3)
- ○ I have an Associates degree in horticulture, but no bachelor or higher degree in this field. (4)
- ○ I have a Bachelor's degree in horticulture (BA,BS), but no graduate degree in horticulture. (5)
- ○ I have Bachelor's and post-graduate (M.S. or higher) degrees in horticulture. (6)
- ○ I obtained a Master's or Doctorate degree in horticulture, but hold a Bachelor's degree in another discipline. (7)

Q1.4 Please select the choice that describes your informal and outside professional experiences in horticulture (excluding work as an Extension employee). Note: these

could be from your experiences as a youth, your own recreational gardening, growing horticultural crops as a side business endeavor, or some employment relating to horticulture outside of Extension.

○ I have had many direct experiences in the area of horticulture, either privately or professionally, that have helped me become proficient in this subject area. (1)

○ I have had a moderate amount of direct private or professional experiences in the area of horticulture. I have a reasonably good grasp on this subject area, but also have room to improve. (2)

○ I've had a few or small number of direct experiences in horticulture. My limited experience has given me some basic knowledge in this subject area, but there is much I don't know or am unfamiliar with. (3)

○ I've had very few direct experiences in horticulture. My knowledge and understanding in this subject area is minimal. (4)

○ I've really had no direct personal experiences or outside employment in horticulture. This is a subject area I am personally unfamiliar with. (5)

Q15 My county office staff includes one or more persons who are designated by the agency as a County Extension Agent-Horticulture (CEA-Hort)? Yes (1) No (2)

Q16 Select the choice that best describes the overall horticultural interest among clientele in your county:

- ○ Horticultural interests and topics are very important in my county, and I spend a good deal of time answering horticultural questions. (1)
- ○ Horticultural interests and topics are moderately important in my county, and I spend similar time on horticulture as I do other agricultural science disciplines (range mgt, animal science, etc.). (2)
- ○ Horticultural interests and topics are NOT very important in my county; I spend little time on this subject. (3)

Q17 Using the gauge below as a 0-10 scale, rate your perceived change in demand for horticultural information among your county clientele since the time you started in your present county position:

Note: 0=No change; 1-3=slight increase; 4-6=moderate increase; 7-8=high increase; 9-10=very high increase

Q18 Agent Perceptions Subset 2

Please rate your agreement with the following six statements about training you have received in the subject area of horticulture as an Extension employee:

	Disagree Strongly (1)	Disagree (2)	Neither Agree or Disagree (3)	Agree (4)	Agree Strongly (5)
I have received agency training that has helped me be able to handle most horticulture questions and problems in my county: (1)	○	○	○	○	○
I have received agency training in horticulture, but it has not helped me enough in my ability to handle horticultural questions and problems: (2)	○	○	○	○	○
I have not received agency training to help me deal with horticulture questions and problems in my county. (3)	○	○	○	○	○
More agency training in the subject area of horticulture would help me as an extension agent. (4)	○	○	○	○	○

Specialist availability and on-line resources are adequate for me to manage horticultural questions and problems in my county without additional training. (5)	○	○	○	○	○
I can increase my ability to manage horticultural questions and problems on my own well enough without additional agency training. (6)	○	○	○	○	○

Q19 When I encounter a horticultural question or problem from a client that I do not know the answer or diagnosis, ***my first action*** is to:

- ○ Search the Internet--Google, Yahoo, Bing, etc. (1)
- ○ Go to a website I know that I expect to have the answer. (2)
- ○ Try to contact an Extension Specialist/Program Specialist by Email, Phone, Lync, etc. (3)
- ○ Ask the question on eXtension 'Ask an Expert' website. (4)
- ○ Try to contact a County Horticulture Agent in my District or elsewhere in the agency. (5)
- ○ Ask a Master Gardener or other knowledgable citizen in my county. (6)

Q20 When previously faced with a horticultural question or problem that I did not know the answer or diagnosis, I have used the following methods to find the answer. ***CHECK ALL THAT APPLY!***

- ☐ Search the Internet--Google, Yahoo, Bing, etc. (1)
- ☐ Go to a website I know that I expect to have the answer. (2)
- ☐ Try to contact an Extension Specialist/Program Specialist by Email, Phone, Lync, etc. (3)
- ☐ Ask the question on eXtension 'Ask an Expert' website. (4)
- ☐ Try to contact a County Horticulture Agent in my District. (5)
- ☐ Ask a Master Gardener or other knowledgeable citizen in my county. (6)
- ☐ Other: (7)

Q21 Agent Perceptions Subset 3.

Please rate your level of disagreement or agreement with the following 8 statements about Horticultural Specialists and resource availability within Texas A&M AgriLife Extension:

	Disagree Strongly (1)	Disagree (2)	Neither Agree or Disagree (3)	Agree (4)	Agree Strongly (5)
Specialists and Program Specialists in Extension Horticulture usually know the answer to horticulture questions that I cannot answer. (1)	○	○	○	○	○
Specialists and Program Specialists in Extension Horticulture return phone calls in a timely manner. (2)	○	○	○	○	○
Specialists and Program Specialists in Extension Horticulture reply to Emails in a timely manner. (3)	○	○	○	○	○
I cannot always be assured that questions will be answered in a timely manner and need additional resources. (4)	○	○	○	○	○

Online resources (fact sheets and web content) created by AgriLife Extension across all agricultural subjects is sufficient for me to help clients in my county. (5)	○	○	○	○	○
Online resources (fact sheets and web content) created by AgriLife Extension in the subject area of Horticulture is sufficient for me to help clients in my county. (6)	○	○	○	○	○
I know where to go within AgriLife Extension resources to find information across all agricultural subjects. (7)	○	○	○	○	○
I know where to go within AgriLife Extension resources to find information pertaining to Horticulture. (8)	○	○	○	○	○

Q22 My county has its own Master Gardener volunteer program: Yes (1) No (2)

Q23 My county has a shared Master Gardener volunteer program with one or more other counties: Yes (1) No (2)

Q24 Agent Perception Subset 4. Please rate your level of agreement or disagreement with the following three statements about the Master Gardener volunteer program in your county.	Disagree Strongly (1)	Disagree (2)	Neither Agree or Disagree (3)	Agree (4)	Agree Strongly (5)
The Master Gardener volunteer program associated with my county is an effective resource for answering horticultural questions and problems in my county. (1)	○	○	○	○	○
The Master Gardener program reduces my need to stay abreast of horticultural topics/problems in my county. (2)	○	○	○	○	○

The Master Gardener program increases my need to stay abreast of horticultural topics/problems in my county. (3)	○	○	○	○	○

APPENDIX C.

IRB APPROVAL LETTER

DIVISION OF RESEARCH

TEXAS A&M UNIVERSITY

APPROVAL OF RESEARCH
Using Expedited Procedures
(Common Rule – Effective January 2018)

January 23, 2020

Type of Review:	Submission Response for Initial Review Submission Form
Title:	Horticultural competency needs and professional development strategies for Texas agricultural and natural resource extension agents
Investigator:	Philip W Shackelford
IRB ID:	IRB2019-1228
Reference Number:	100649
Funding:	
Documents Approved: *copies of stamped approved documents are downloadable from iRIS	IRB Application (Human Research) - (Version 1.2) Informed consent--Agents - (Version 4.1 Approved on 01/23/2020) Informed consent--Specialists - (Version 2.1 Approved on 01/23/2020) Dissertation Research Proposal4.0 - (Version 1.0) Study 2 Recruitment text for email or phone - (Version 1.0 Approved on 01/23/2020) Study 1 Recruitment Email - (Version 1.0 Approved on 01/23/2020) Study 1 survey instrument - (Version 1.1 Approved on 01/23/2020) Study 2 interview question guide - (Version 1.0 Approved on 01/23/2020)
Special Determinations:	Waiver approved under 45 CFR 46.117 (c) 1 or 2/ 21 CFR 56.109 (c)1
Risk Level of Study:	Not Greater than Minimal Risk under 45 CFR 46 / 21 CFR

750 Agronomy Road, Suite 2701
1186 TAMU
College Station, TX 77843-1186

Tel. 979.458.1467 Fax. 979.862.3176
http://rob.tamu.edu

	56
Review Category:	Category 7: Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies

Dear Philip W Shackelford:

The IRB approved this research on 01/23/2020.

Before 12/22/2020, you are to submit an Administrative Check-In Form to the HRPP/IRB. If the HRPP/IRB does not receive the form, there will be no approval of new research after 01/22/2021.

In conducting this research, you are reminded of the following requirements:

- You must follow the approved protocol;
- Any changes to the research must be submitted to the IRB for review and approval prior to implementation;
- Unanticipated problems or other reportable events (including protocol deviations) as described in "HRP-029 Reportable New Information" must be reported to the IRB within 5 working days of learning of the incident;
- You must notify the IRB of study completion.

If you have any questions, please contact the IRB Administrative Office at 1-979-458-4067, toll free at 1-855-795-8636.

Sincerely,
IRB Administration

APPENDIX D.

MAIN SURVEY RECRUITMENT EMAIL

(January 31, 2020)

Dear ANR Agents,
You are receiving this Email as a request to participate in an online survey of Texas A&M AgriLife Extension Service ANR Agents. The questions asked in this survey were developed for a research project exploring how extension agents such as yourself gain and desire to gain competency in certain agricultural subjects, like horticulture, the focal subject in this study.

The hyperlink below will take you to a Qualtrics online questionnaire, which takes approximately 20 minutes to complete. You may participate from a desktop/laptop computer, tablet, or smartphone. If you are unable to complete the survey in one setting, you may return and complete it later. **We do ask that you attempt to participate by Feb 11th,2020**.

Your timely and genuine responses are important to the research questions being asked in this project. Please take the questionnaire only once, and do not forward or share the link with anyone else. All of the introductory statements on the opening screen under *Extension Horticulture Training Assessment* apply to you, including the anonymity/confidentiality of your responses and your right to not participate in this social science research project. If you have any questions, please don't hesitate to contact Dr. Philip Shackelford, the Project Investigator, Dr. Jeff Ripley, Associate Director for County Programs, or myself.

My cell phone contact should you need it is (979) 676-3280.

TAKE THE SURVEY BY CLICKING ON THIS LINK:

https://agrilife.az1.qualtrics.com/jfe/form/SV_73YpvIuwXkWosXb

Thanks for your assistance!

Monte L. Nesbitt
Extension Program Specialist II
Dept. of Horticultural Sciences
Mailstop 2134
Texas A&M University
College Station, Texas 77843
(979) 862-1218 office

TEXAS A&M AGRILIFE EXTENSION

APPENDIX E.

CURRICULUM VITAE, MONTE L. NESBITT

Texas A&M AgriLife Extension Service

Current Title:	Extension Program Specialist II
Initial Appointment	October 1, 2009
Program Unit	Horticultural Sciences
Program Area	Pecan, citrus and general fruit production
Appointment	100% Extension

Current Position Description

Provides leadership in the area of pecan and perennial fruit production for the state of Texas; gives educational presentations at county field days, grower workshops and scientific conferences. Assists growers with problem identification, orchard development and integrated pest management recommendations. Writes and develops educational fact sheets, popular press articles, and journal-ready publications for growers and the scientific community. Serves as an advisor to commodity organizations, including the Texas Pecan Grower's Association, Texas Fruit Grower's Association, and the Texas Association of Olive Oil.

Professional and Academic Experience

Education

M.S. Horticulture, Texas A&M University, College Station, Texas, December 1992.

B.S. Horticulture, Texas Tech University, Lubbock, Texas, December 1987.

Professional Work History

2015-present Extension Program Specialis II, Texas A&M AgriLife Extension

2009-2015 Extension Program Specialist I, Texas A&M AgriLife Extension, Department of Horticultural Sciences, College Station, Texas.

1994-2009 Agriculture Program Associate, Auburn University, Department of Horticulture, Gulf Coast Research & Extension Center, Fairhope, Alabama.

1993-1994 Agricultural Science Technician, USDA/ARS Pecan Breeding and Genetics, College Station, Texas.

1990-1993 Graduate Teaching Assistant, Department of Horticultural Sciences, Texas A&M University, College Station, Texas.

1988-1990 Research Technician, Department of Horticultural Sciences, Texas A&M University, College Station, Texas.

Honors and Awards

2016- Texas A&M AgriLife Extension Superior Service Award, Program Specialists

2014- Southern Region ASHS Extension Communications Award, *Earth-Kind Landscape Manual* (Authors: Gu, Woodson, Drees, George, Masabni, Nesbitt, Ong, Provin, Wherley, Welsh, Niu, Pitt, LaChance, York, Thomas, White, Fontaineir, Smith, Hejl); 2009- Superior Service Award, Alabama Pecan Growers Association; 2008- Special Service Award, Georgia Pecan Growers Association

Selected Peer-Reviewed Publications

Lombardini, L., Volder, A., **Nesbitt, M.L**. and D.L. Cartmill. 2013. Consequences of injury caused by *Cameraria caryaefoliella* (Lepidoptera: Gracillariidae) on pecan gas exchange and chlorophyll fluorescence. J. Amer. Soc. Hort. Sci. 138(4):263–266. 2013.

Miyamoto, S. and **M. Nesbitt**. 2011. Effectiveness of soil salinity management practices in basin-irrigated pecan orchards. HortTechnology 21:569-576.

Nesbitt, M.L., Ebel, R.C. and W.A. Dozier. 2008. Production practices for Satsuma mandarins in the Southeastern U.S. HortScience 43:290-292.

Nesbitt, M.L., W.D. Goff, and L. A. Stein. 2002. Effect of scionwood packing moisture and cut-end sealing on pecan graft success. HortTechnology 12(2):257-260.

Nesbitt, M.L., R. C. Ebel, D. Findley, B. Wilkins, F. Woods, and D. Himelrick. 2002. Assays to assess freeze injury of Satsuma mandarin. HortScience 37(6)871-877.

Wood, B.W., W.D. Goff and **M.L. Nesbitt.** 2001. Pecans and hurricanes. HortScience 36(2) 253-258.

Nesbitt, M.L., N.R. McDaniel, R.C. Ebel, W.A. Dozier, and D.G. Himelrick. 2000. Performance of Satsuma mandarin protected from freezing temperatures by microsprinkler irrigation. HortScience 35(5) 856-859.

Nesbitt, M.L., W.D. Goff, and N.R. McDaniel. 1997. Performance of 14 pecan genotypes in South Alabama. Fruit Varieties Journal. 51(3) 176-182.

Thompson, T.E., W.D. Goff, **M.L. Nesbitt**, R.E. Worley, R.D. O'Barr, and B.W. Wood. 1997. 'Creek' pecan. HortScience. 32(1) 141-143.

Selected Conference & Symposia Proceedings

Heerema R., L. Wells, L. Lombardini, **M. Nesbitt**, C. Warren, Y. Gong, and R. Pegg. 2014. Pecan kernel antioxidant capacity and oil composition are affected by mechanical pruning and by nut position in tree canopy. 29th ISHS Congress. Brisbane, Australia. Aug. 7-22, 2014.

Nesbitt, M. 2010. Pecan phenology and implications for nutrition. Western Pecan Growers Assoc. Proceedings. Vol. 44

Selected Extension Publications

Nesbitt, M. & R. "Skip" Richter. 2014. Protecting Landscapes and Horticultural Crops from Frosts and Freezes. Texas A&M AgriLife Ext. Bull. EHT-048.

Nesbitt, M., Stein, L. & J. Kamas. 2013. Texas Fruit & Nut Production: Blackberries. Texas A&M AgriLife Ext. Bull. E-602.

Selected Popular Press/Industry Publications

Nesbitt, M.L. 2018. "Five Costly Scab Control Mistakes" Pecan South Vol 51 (2).

Nesbitt, M.L. 2018. "Water Needs of Pecan Trees: Revisiting McFarland & Worthington's Lysimeters", Pecan South Vol. 51 (5).

Book Chapters

Nesbitt, M.L. 2013. Fruit trees and small fruits for Earth-Kind landscapes, p. 81-92. In: M. Gu (ed.) Earth-Kind Landscape Management, HT-013, Texas A&M AgriLife Extension Serv.

Nesbitt, M. and L. Wells. 2007. Estimation of pecan tree value, p. 135-136. In Wells (ed.) Southeastern Pecan Growers Handbook. Univ. of Geogia Coop. Ext. Serv. Bulletin 1327.