ABSTRACT

GLEN, CHARLOTTE DAWSON. Demonstration Gardens as Teaching Tools in Extension Horticulture Programs: Their Characteristics, Utilization, Target Audiences, Benefits, and Challenges as Implemented by Horticulture Extension Agents in North Carolina. (Under the direction of Dr. Gary Moore).

The purpose of this study was to investigate how horticulture Extension agents in North Carolina utilize demonstration gardens as teaching tools in their Extension education programs. This study identified the characteristics of demonstration gardens currently maintained by North Carolina horticulture Extension agents. In addition, the educational utilization of gardens, targeted audiences, types of features, techniques, and practices incorporated to enhance educational effectiveness, and the benefits and challenges of choosing demonstration gardens as an educational delivery method for Extension horticulture programming were studied.

Data was collected through a telephone survey and a web based survey, which included three scales to measure agents' perceptions of the challenges, benefits, and competencies needed to utilize demonstration gardens. A total of 38 horticulture agents participated in the study, of which 35 were found to currently utilize 50 demonstration gardens located in 34 different counties. Data was analyzed using descriptive statistics. Based upon the findings, the following conclusions were identified:

1. Demonstration gardens can be part of any Extension horticulture program but are not “one size fits all” and there is no formula for the “right” Extension garden. The size, location, and plant composition of gardens vary depending on the agent’s reason for creating the garden, reflecting their program’s priorities and needs.

2. The utilization of demonstration gardens by North Carolina horticulture agents is increasing.
3. Developing, maintaining, and utilizing demonstration gardens requires significant support. Master Gardener Volunteers are key supporters of Extension demonstration gardens in North Carolina.
4. Horticulture agents are using demonstration gardens to enhance and support their educational efforts, to demonstrate multiple principles and practices, and to enhance their overall horticulture program.
5. Demonstration gardens are being utilized to serve multiple audiences, most commonly home gardeners, Master Gardener Volunteers, and youth.
6. North Carolina Horticulture agents are not fully evaluating the impact of demonstration gardens and few of their demonstration gardens fully support self directed learning.
7. Availability of time, funding, and volunteer support are the greatest challenges of choosing demonstration gardens as an educational delivery method.
8. Demonstration gardens enhance the educational effectiveness of Extension horticulture programs, effectively engage volunteers, and provide meaningful opportunities for volunteer service and for developing partnerships.
9. NC horticulture Extension agents utilizing demonstration gardens have the skills and knowledge necessary to install and maintain demonstration gardens but require additional training to evaluate their garden's impacts and to develop gardens that fully support self directed learning.

Demonstration Gardens as Teaching Tools in Extension Horticulture Programs:
Their Characteristics, Utilization, Target Audiences, Benefits, and Challenges
as Implemented by Horticulture Extension Agents in North Carolina

by
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A thesis submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Master of Science

Extension Education

Raleigh, North Carolina

November 3, 2010

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BIOGRAPHY

Charlotte Dawson Glen was born and raised in Jones County, NC. She currently resides in Pender County, NC, with her husband, Alistair, and their two children.

Her long time interest in horticulture began as child in her grandmother's flower garden and her grandfather’s watermelon patch. Mrs. Glen attended NC State University in 1992 and 1994, majoring in horticulture. In 1993 she participated in a yearlong internship sponsored by Scottish Heritage, USA, at Threave Gardens in Castle Douglas, Scotland. She later interned at Longwood Gardens in Kennett Square, PA, and moved to New Zealand, transferring her degree to Lincoln University, Canterbury, New Zealand, from which she graduated in 1998 with a bachelor's degree in horticulture. Upon returning to the United States, Mrs. Glen began her career with NC Cooperative Extension in Jan. 2000.

For the past ten years, Mrs. Glen has served as a horticulture agent with NC Cooperative Extension, working primarily with consumer horticulture and the Master Gardener Volunteer program, in Johnston, New Hanover, and Pender County, where she currently serves.

ACKNOWLEDGEMENTS

I would like to thank my advisory committee, Dr. Gary Moore, Dr. Jay Jayaratne, and Dr. Lucy Bradley, for their guidance in completing my master's thesis.

I would also like to thank Dr. Sydney Park Brown, of the University of Florida, for her feedback and assistance with pilot testing my instrument.

In addition, I would like to thank my family for their support through this process, my parents, who have encouraged me all my life though in different ways, and my grandmother and grandfather for teaching me the wonder that could be found in a garden.

Most importantly I would like to thank and acknowledge the many horticulture agents and Master Gardener Volunteers who have chosen to share their knowledge and passion for horticulture by developing and maintaining demonstration gardens.

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CHAPTER 1: INTRODUCTION

Google “demonstration gardens” and “Cooperative Extension” and one will quickly realize how extensively this teaching method is employed in Extension horticulture programming. For example, the Florida Cooperative Extension Service utilizes a network of 61 demonstration gardens located in 40 of the state’s 67 counties to reach out to homeowners, youth, Master Gardener volunteers, green industry professionals and others (Brown, Taylor, and Eubanks, 2007). These gardens support horticultural and environmental educational programming and include demonstrations of proper plant selection for site conditions, storm water best management practices, wildlife habitat, composting, water conservation methods, and plant trials for performance evaluation. As a modified form of the on-farm test, demonstration gardens provide valuable experiential learning opportunities and are particularly suitable for providing information to clientele who are prepared to try a new practice (Richardson, Jenkins, and Crickenberger, n.d.). Among horticulture Extension agents in North Carolina, the development and use of demonstration gardens is increasing, with demonstration gardens in place or under development in approximately 35 North Carolina counties, according to Lucy Bradley, North Carolina State University’s Urban Horticulture Extension Specialist (personal communication, December 7, 2007). As part of an Extension education program, demonstration gardens can support non formal education efforts, enable self directed learning, and enhance overall program effectiveness. When effectively developed and utilized for these purposes, gardens have the potential to affect change in the behavior of thousands of North Carolina citizens participating in Extension’s horticulture education programs, and to generate positive social, environmental and economic impacts across the state.

Statement of the Problem

Though demonstration gardens are being widely implemented by horticulture Extension agents in North Carolina and other states, little research has been conducted to determine their characteristics, how they are being used, and the challenges and benefits of their utilization as part of an Extension education programs. This lack of research based knowledge potentially limits agents' ability to fully utilize gardens to enhance their programs. A broader knowledge base about how demonstration gardens can be employed as teaching tools and the features, techniques, and practices that can enhance their effectiveness will assist agents in maximizing the outcomes possible from choosing this delivery method. In turn, this will provide targeted audiences with quality educational experiences that have the potential to affect knowledge levels, skills, attitudes and aspirations, leading to long term behavior change and positive social, environmental, and economic impacts for them as individuals and for their communities.

Purpose of the Study

The purpose of this study was to investigate how horticulture Extension agents in North Carolina utilize demonstration gardens as teaching tools in their horticulture education programs. In addition, this study identified features, techniques, and practices that agents are incorporating into demonstration sites to enhance educational effectiveness. More specifically, the study answered the following research questions:

Research Questions

1. What are the characteristics of demonstration gardens currently utilized by North Carolina horticulture Extension agents?
2. How are horticulture agents in North Carolina utilizing demonstration gardens in their Extension education programs?
3. Which audiences are targeted?
4. What features, techniques, and practices are employed by agents to enhance the educational effectiveness of demonstration gardens for self directed learning?
5. What are the challenges of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?
6. What are the benefits of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?
7. What competencies do North Carolina horticulture Extension agents require to develop, maintain, and utilize demonstration gardens as an educational delivery method for Extension horticulture programming?

Implications and Educational Significance

As a result of this study, an accurate picture of the demonstration gardens currently employed within North Carolina Cooperative Extension was created, including their characteristics, utilization, target audiences, challenges and benefits. In addition, features, practices, and techniques agents are employing to enhance the educational effectiveness of demonstration gardens have been identified. This information will be beneficial to horticulture Extension agents who currently have or are considering developing a demonstration garden by facilitating a greater understanding of the role demonstration gardens can play within Extension horticulture education programs, along with the challenges and benefits of employing them as an educational tool, and by presenting information on how to increase a demonstration garden's educational effectiveness. It will also increase awareness of the utilization of this educational delivery method among decision makers in Extension administration, focusing attention on training and resource development needed to increase the impact of programs utilizing demonstration gardens and providing information useful for statewide marketing of Extension's programs through these gardens. Increased knowledge, more resources, and a greater awareness of the scope of demonstration gardens statewide will assist agents in creating successful demonstration gardens and utilizing them in educationally effective programs, resulting in more efficient use of resources and the development of effective educational programs that lead to positive behavior changes and lasting impacts for North Carolina's citizens and communities.

Additionally, this study addresses several priority initiatives identified by the American Association for Agricultural Education's (AAAE) National Research Agenda for Agricultural Education and Communications, predominantly within research priority area three: Identify appropriate learning systems to be used in nonformal educational settings (AAAE, n.d.).

Limitations of the Study

Limitations of this study are due to its location and time specificity. This study looked at the status of demonstration gardens in North Carolina at one point in time and does not provide information on their historical use and development or their projected future growth and trends. Though the information presented in this study will be of interest to Extension agents throughout the United States, the specific findings are applicable to North Carolina Cooperative Extension only. In addition, at least one horticulture agent position vacancy at the time of the study has contributed to incomplete coverage of all existing demonstration gardens.

Definitions of Terms

Cooperative Extension – A non-formal educational outreach network designed to help people put research-based knowledge to work to improve their lives. The service is based within each state's designated land grant universities and is administered at the national level through the National Institute of Food and Agriculture of the United States Department of Agriculture.

Cooperative Extension Agent - a university employee who develops and delivers non formal educational programs to assist people in the areas of economic and community development, youth leadership and 4-H, family issues, agriculture (including horticulture), and natural resources and the environment. Sometimes simply referred to as an Extension agent, county agent, or by their area of responsibility, e.g. horticulture agent.

Demonstration garden – For the purpose of this study, a demonstration garden is defined as a landscape or garden planting designed and maintained under the supervision of a horticulture Extension agent for the purpose of teaching horticultural principles and practices as part of an Extension education program. A demonstration garden may refer to a single bed planted with one specific theme or a series of gardens designed to teach about many different ideas or practices.

Educational delivery method – The method an educator chooses to deliver information to program participants. Examples of educational delivery methods used in Cooperative Extension include workshops, newsletters, on-farm tests, tours, field days and many more. More than one educational delivery method is often used in an Extension program. Also referred to in this study as a **teaching tool**.

Educational settings – The system in which education takes place, based upon various attributes including the presence of an instructor and their role in the learning process, how learning is assessed and rewarded, learner's motivation, and the location where learning takes place. May be categorized as **formal**, **non formal,** or **informal**, though distinct lines do not exist from one category to the next. These formats are instead usually pictured along a continuum with one format extending into the next. **Formal education** is associated with K-12, university, and college degree programs, which result in diplomas and degrees, take place in classroom settings, and are instructor supervised and assessed. **Non formal education** is also supervised and usually takes place in a classroom-type setting, learning may result in certification, but is usually undertaken voluntarily or for intrinsic reasons. **Informal education** or **informal learning** can happen anywhere and is the result of the personal desire to gain knowledge. Sometime referred to as **self directed learning**, rewards for this type of learning are intrinsic and learning is not assessed by an outside entity. The term **free choice learning** was create by Falk and Dierking (2000) to refer to the type of informal learning that takes place in museum type settings, which include gardens .

Experiential learning – defined by the Association of Experiential Education as a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflections in order to increase knowledge, develop skills, and clarify values (Gilbertson, Bates, McLaughlin, & Ewert, 2006, p.6).

Green industry – The industry created through the businesses and companies that provide goods and services related to landscape design and maintenance, the propagation and cultivation of ornamental plants, and turf production and care. Individuals that work in this industry are referred to as **green industry professionals**, and include those who work for landscape design, installation and maintenance companies, turf production and management companies, and commercial nurseries and retail garden centers.

On-farm test - a process in which an innovative practice or solution to a problem is tested on an actual farm to demonstrate its viability or to test its applicability (Richardson, Jenkins & Crickenberger, n.d.). This educational delivery method is often employed in Cooperative Extension programs.

Horticulture program – Non formal education program developed and delivered by Extension agents to address needs and issues of the green industry, commercial fruit and vegetable production, as well as homeowner lawn, garden, and landscape informational needs and issues.

CHAPTER 2: REVIEW OF LITERATURE

Since its beginning in the early 20^{th} century, Cooperative Extension has utilized on-farm tests as a valued educational delivery method to teach new practices to American farmers (Pigg, 1983). Defined as "a process in which an innovative practice or solution to a problem is tested on an actual farm to demonstrate its viability or to test its applicability (Richardson, Jenkins & Crickenberger, n.d.)", on-farm tests continue to be a widely employed educational delivery method, though their range has extended beyond the farm gate. The past 100 years have seen a tremendous shift in the American population, from a society that was primarily rural and agrarian-based to today's information age, predominantly urban population. For many Americans today, their farm is their home landscape. Extension programs wishing to reach these Americans have taken the on-farm test and modified it to meet the needs of this audience by creating gardens to demonstrate innovative practices and solutions for home landscapes, thus the name demonstration gardens.

Within an Extension horticulture program, demonstration gardens can be used to enhance non formal education efforts by providing valuable experiential learning opportunities in the form of hands-on activities and by providing a site where agents and trained volunteers can lead demonstrations of correct horticultural practices, such as a pruning demonstration (Pigg, 1983). As in museums, when properly designed and interpreted these gardens can also enable informal, self directed learning by providing an educative environment where individuals, families, and groups can learn on their own, independent of a designated instructor (Falk and Dierking, 2000). Demonstration gardens can further support horticulture programs by initiating community collaborations and partnerships (Renquist, 2005) and through engaging volunteers in learning and leadership (Mayfield and Theodori, 2006).

The Garden as a Teaching Tool

A garden is made up of living, growing plants, arranged in combination with other real objects such as pathways, irrigation systems, arbors, trellises and other landscape features. Gardens are tangible, physical representations of the theoretical knowledge needed for their creation and maintenance – plant selection, design theory, soil preparation, cultivation practices, and much more. As well as being visually stimulating, gardens invite participation. Fragrances waft on the air, textures and colors entice those wandering through, birds sing and sunlight warms creating a rich multi-sensory experience in which visitors can immerse themselves in sight, sound, touch, smell, and action. It is this genuine, concrete, tangible and engaging quality that makes gardens places of learning, rendering them exceptional teaching tools for horticulture programs seeking to teach horticulture and environmental practices and principles. This quality is at the heart of experiential learning, which at its most basic can be defined as learning through real experiences (Smith, 2001).

As a teaching method, experiential learning requires much more than just real experiences and it is the role of the instructor to ensure that students are having a learning experience that is educative rather than one that is non or mis-educative (Gilbertson, Bates, McLaughlin, & Ewert, 2006). While the value of direct experiences in education was first championed in this country in the 1930's and 1940's by philosopher and education reformer John Dewey (Gilbertson, et. al., 2006, p. 9), a theoretical framework for how people learn from experiences was not solidified until 1984, when David Kolb proposed what is now known as Kolb's Experiential Learning Cycle. Kolb's cycle is composed of four phases: 1) Concrete experience – in which the learner is involved in a specific experience that can occur as part of day to day living or be deliberately structured into learning activities to provide real experience with the subject matter being taught; 2) Reflective observation – in which the learner reflects on the experience, taking into account different points of view to provide meaning to the experience; 3) Abstract conceptualization – in which the learner integrates past experiences with meanings from this experience to develop explanations and draw conclusions; and 4) Active experimentation – in which the learner uses these conclusions to guide and implement decisions and actions that create new experiences (MacKeracher, 2004, p. 57). Demonstration gardens can provide the real experiences needed to accomplish this cycle of learning, both at a casual, self directed level for informal learning, as well as at an intentional, planned level to enhance formal and non formal education efforts.

The effectiveness of Extension's non formal education programs can benefit greatly from the inclusion of experiential learning opportunities that gardens can provide. In fact, Richardson (1994) states "our educational program delivery systems should include delivery methods that provide opportunities for clientele to gain a sensory, exploratory experience with the information being presented". In a study he conducted of the preferred learning methods of North Carolina Cooperative Extension clientele, Richardson (1994) found an “overwhelming preference” for learning by doing as the single most preferred learning method, indicated by 70% of study participants. When asked which combinations of learning methods helped them learn better, participants’ responses “were strongly focused on combinations of methods that allow them to gain an interactive, sensory experience when learning”, with the combination of seeing and doing being most preferred (Richardson, 1994). As well as hands-on experiential learning experiences, gardens can also be the setting for both result and method demonstrations to enhance classroom instruction. While result demonstrations show the results of a specific action, such as the effect of using different amounts of fertilizer, and are useful for providing knowledge that can be characterized as factual or descriptive data, method demonstrations involve an agent or trained volunteer guiding a learner through all the necessary tasks needed to accomplish a desired result (Pigg, 1983). Both types of demonstration allow the learner to gain experience with the information being presented, though method demonstration may be more effective at encouraging behavior change (Pigg, 1983). The use of result demonstration has been shown by Harmon and Jones (1997) to increase learning when used as a supplement to classroom instruction in non formal education. Their study investigated the use of field demonstrations of forestry harvesting practices to illustrate concepts being taught to land owners, foresters, tree farmers, timber harvesters and timber buyers. In this study, participants in five forestry stewardship workshops were divided into three groups. The first group, the control, completed a questionnaire containing both objective and subjective questions about forestry management practices upon arrival at the workshop. The second group, referred to as slide only, completed the questionnaire after sitting through a slide presentation on the material, and the third group, slides/field tour, completed the questionnaire after sitting through the slide show and participating in a walking tour of the field demonstration. Significant increases (at the $p<0.05$ level) in learning were found between the control and slide only groups as well as between the slide only and slides/field tour group, indicating that participants “appear to learn most when a traditional classroom experience (using slides) is followed by an experience in the field, where visitors witness concepts first-hand (Harmon & Jones, 1997)”. In addition to increased learning, participants who experienced both the field tour and slide show exhibited attitude changes toward one specific practice, becoming more accepting of clear cutting as a timber harvesting practice.

In other studies looking at the effect of site visits on classroom learning, teachers have reported increased motivation to learn, increased interest and receptivity to learning, and greater enthusiasm and attentiveness in the classroom as a result of the site visit (Borun, 2001). While Borun specifically studied elementary school children visiting a science museum, others have looked at student perceptions of a demonstration garden on classroom learning. College students enrolled in a landscaping course at the University of Florida’s Indian River Research and Education Center were asked to evaluate the educational value and function of the demonstration garden located at this facility. All students rated the gardens as an “excellent outdoor laboratory resource with broad range applications for other courses”, rating the value of the garden overall as “very good to excellent”, and as “excellent for reinforcing lecture and lab concepts” (Wilson, Minton, Mecca, & Gersony, 2004).

Extension agents can employ demonstration gardens as teaching tools to enhance non formal education in several program areas and with multiple audiences. Horticultural Extension agents in Florida use gardens to demonstrate and enhance learning in areas including composting, creating wildlife habitat, choosing the right plant for site conditions, storm water best management practices, and environmental landscape design and maintenance principles in programs for youth, families, homeowners, Master Gardener volunteers, and green industry professionals (Brown, Taylor, & Eubanks, 2007). The use of gardens to teach horticultural and environmental principles and affect behavior change extends well beyond Extension. For example, nearly 50% of visitors to the Water Conservation Garden located in San Diego, CA who participated in a survey indicated they have made changes to increase water conservation in their home landscapes as a result of their visit to the garden (Eberhardt, 2007). Other gardens are being designed to serve as the educational delivery method for lessons in sustainable development and ecological citizenship, namely the Botanical Garden at the Orange County Great Park, currently under development in Irvine, CA (Marinelli, J., 2007). Education through gardens can have impact in many areas Extension endeavors to reach. At the 2007 State Extension Conference held by North Carolina Cooperative Extension (NCCE) in Raleigh, the utilization of gardens were given as an example of how agents could achieve integrated programming to create impacts in all of NCCE’s strategic priority areas. Identified goals that could be addressed through gardens included health and nutrition, agricultural education, horticultural knowledge and skills, youth development, community development and environmental stewardship at both the individual and community level (Guion & DeBord, 2007).

The Garden as a Museum

In addition to enhancing non formal education efforts, demonstration gardens can enable informal, self-directed learning and in this sense the type of learning that occurs within them is akin to the type of learning that occurs in museums. In their detailed text on the topic, *Learning from Museums*, Falk and Dierking (2000) define museums as public places for personal learning and include under the generic term museum “art, history, and natural history museums; science centers; historic homes; living history farms and forts; aquariums; zoos; arboretums; botanical gardens; and nature centers (p.xi)”. Falk and Dierking use the term free choice learning to describe the type of learning that occurs in museums, noting that this type of learning is personally motivated, self directed, often non linear, and emotionally and personally rewarding. Much of what adults know and learn through life is due to free choice learning, which is often intrinsically motivated and highly effective. Based upon years of research in museum learning and the review of over 500 studies, Falk and Dierking have developed a model of learning in museums based on the premise that all learning is dependent upon and shaped by the context in which it occurs. Called the Contextual Model of Learning, it is a model that describes museum learning rather than predicts it, and is composed of three overlapping, interrelated contexts that shape museum learning experiences: the personal, the socio-cultural, and the physical.

Each of these contexts contributes to and shapes learning. The personal context is comprised of the learner's motivations and expectations, their prior knowledge, interests and beliefs, and the personal choice and control over learning that museums provide. All learning is highly personal because meaning is attached to the new information we encounter based upon our prior experiences and existing knowledge, which are unique to each individual. Though we are constantly bombarded with information, we screen and filter out that which is not personally meaningful and relevant, letting in only that information which is relevant to our personal state, therefore learning is facilitated by a personal interest in the subject. Individuals self select to visit museums (or gardens) because of their intrinsic motivations and interests, and the learning that results from intrinsic reasons has been shown to be highly effective. (Falk and Dierking, 2000).

The socio-cultural context effects free choice learning because much of who we are, how we behave and how we perceive ourselves and the world is the product of the culture in which we are immersed. Our past experiences and current and past perceptions are based upon the culture, defined as a collection of shared beliefs and customs, in which we exist. In addition, Falk and Dierking posit that learning is fundamentally a social experience, that much of the way we make sense of the world is through social interactions with others and that museums are places of socially facilitated learning (2000). While our socio-cultural context is dominated by the culture in which we live and the people around us, our physical context is the physical setting and the real, tangible objects in which we are situated. These physical details create persistent memories which facilitate future learning by providing a physical setting in which to frame our prior experiences. Falk and Dierking state that all learning appears to be bound to the environment in which it occurs, and as such, it is "probably the ability of exhibitions to organize, simplify and contextualize information that makes them such potent teaching tools (2000, p. 122)". When choosing which exhibits to visit, museum visitors are more likely to visit an exhibit whose subject they are already familiar with to reaffirm their existing knowledge. This desire to reaffirm knowledge is beneficial to long term learning and contact with reinforcing experiences outside of the museum are needed to maintain learning. Because of this, museums must be considered as part of the larger education infrastructure which includes both formal and informal learning opportunities (Falk & Dierking, 2000). As a type of museum, gardens must also be considered in the larger infrastructure of learning opportunities available and can be powerful tools for free choice learning when their exhibitions, or plantings, are developed and interpreted based upon practices and techniques shown to enhance educational effectiveness.

Practices and Techniques to Enhance Educational Effectiveness

It has been shown that gardens can be an important self learning resource and strategy for those who are highly intrinsically motivated to learn about gardening (avid gardeners), even when no direction (in the form of planned exhibits with labels) is provided (Hamilton & DeMarrais, 2001). Even so, many experts agree that learning for the majority of visitors will be improved as the result of planned interpretation (Falk & Dierking, 2000), (Serrell, 1996), (Veverka, 2005). Interpretation involves communicating the message of the exhibit to the visitor to engage them in meaning making and facilitate learning, and can be achieved through both static (signage, self guiding tour brochures) and dynamic (guided walks, onsite interpretation presented by a trained staff) forms of delivery (Osland, 2006). Based on years of studying visitor interaction with exhibit labels, Serrell (1996) suggests an interpretive approach in which label content is conceived in context with the “big idea” of the overall exhibition. Serrell’s big idea is a single focus that unifies all parts of the exhibit, an overarching theme, story or communication goal that guides every aspect of exhibit development. For a garden exhibit, the big idea would guide plant selection, plant placement, selection of hardscape materials, interpretive signs and materials, and all other aspects of the garden’s design. Butler and Serrell (2000) promote the use of the “big idea” to guide exhibit content and enhance self directed learning, which can result in both short and long term outcomes. Short term outcomes of this type of learning include knowledge gain, increased curiosity, and improved skills, while long term outcomes include problem solving, behavior change, increased confidence, attitude change, and further learning (Butler and Serrell, 2000).

In addition to the big idea concept, Serrell (1996) offers advice on how to create effective labels by defining 10 deadly sins to avoid when creating labels. Major sins include not addressing visitor’s prior knowledge, not knowing who the audience is, using a vocabulary beyond the majority of visitors, long and wordy labels, labels that do not begin with concrete, visual references, and labels lacking a system of design to organize the message. Serrell also presents 14 helpful research evaluation findings, based on unpublished evaluation studies, published empirical data, and the working knowledge of museum professionals. Findings that are applicable to exhibit labels in gardens include: 1) Visitors read shorter labels more thoroughly than longer labels; 2) Labels placed directly next to what they are about are more likely to be read; 3) Chunking information in short paragraphs, 25 to 75 words long, increases the likelihood of reading; 4) Labels with words and images working together are more meaningful and memorable than all text labels; 5) Adults are more likely to read labels to children when labels are easy to read out loud and do not require paraphrasing or defining unfamiliar words. Reading aloud increases social interaction; and 6) Labels that contain concrete, visually referenced information will increase visitor's tendencies to read and discuss (Serrell, 1996, chap. 20). These suggestions are echoed in the findings of Wandersee & Clary (2007), who used qualitative and quantitative methods to evaluate the Crosby Arboretum's interpretive science signage system, which they identified as "the best we had ever seen in the U.S. and abroad (p. 16)". Their suggestions for trailside science signs are very applicable to demonstration garden settings and include using around 70 words per sign, writing for an 8th grade reading level, having one main topic per sign, supplying both scientific and common names, adding graphics to aid identification, promoting interaction by posing questions, and placing signs frequently along the trail. As a result of their qualitative analysis, Wandersee & Clary recommend that sign messages focus on meaning making and that it is helpful if "each sign raises an interesting question, taps into prior knowledge and experience, involves multiple senses, and communicates a single, potentially memorable message (2007, p. 22)".

Based on their Contextual Model of Learning, Falk & Dierking (2000) suggest several techniques to enhance free choice learning in museum-type settings. Learning enhancement begins by promising a quality visit through marketing materials that connect with visitors' interests and motivations. Once in the museum, interpretive signage should provide hooks and various entry points that relate to visitors' past experiences and there should be choices about what to learn and how to go about learning. In addition, since learning is socially facilitated, conversation should be promoted and enough room provided for groups to experience and interact with an exhibit together. The design of the site should provide an intuitive flow with obvious pathways and visitor facilities well marked to reduce apprehension. Opportunities for continued learning after the visit should be provided, with interactive websites and printed materials suggested as possible delivery methods.

In one of the only studies to directly examine elements that promote learning in gardens, Price (1986) visited four public gardens with an educational focus to develop recommendations for the design and interpretation of gardens to stimulate visitor learning. She found that garden visitors were most likely to acquire knowledge related to plant identification, gardening techniques, and garden design principles as a result of their garden visit. This is very much in agreement with the findings of Hamilton and DeMarrais (2001), who found avid gardeners most commonly visit public gardens to learn about plants, garden design, and garden maintenance techniques. Price's (1986) recommendations for garden design and interpretation were divided into three categories: 1) Exhibit design and interpretation; 2) Support Services; and 3) Programming.

In her recommendations on exhibit design and interpretation, Price (1986) concluded that the educational effectiveness of demonstration gardens would be enriched if design decisions were based upon educational goals and reflected current practices in the field of exhibit design. Specific recommendations for enhancing the educational effectiveness of demonstration gardens made by Price included: 1) Scale – demonstration gardens should be developed on a scale applicable to home gardeners to allow visitors to imagine transferring the concepts demonstrated to their own gardens; 2) Curiosity – to initiate learning, visitor's curiosity should be engaged through the use of color, unusual design, new techniques, or uncommon plants; 3) Highlight problems – to bring the garden to a human level, by showing even professionals have horticultural problems. This also provides opportunities to teach problem solving; 4) Provide solutions – to capture visitor's attention, provide solutions to problems they may be experiencing in their own gardens; 5) Identification labeling – this is expected and looked for by visitors to an educational garden, and a major source of visitor frustration when not present or visible. Identification labels were found to be the most important element for individuals visiting the garden to study horticulture; 6) Story labels – to elaborate and clarify topics for visitors. This is the same as interpretative signage; 7) Handouts and brochures – to encourage continued learning. Visitor interest in and use of brochures and handouts was found to be high.

In the category of support services, Price (1986) made the following recommendations for the design of demonstration gardens to enrich learning: 1) Provide comfortable seating – to rest and linger; 2) Provide water – to drink or sit by; 3) Provide adequate paths for good circulation. Wider paths encourage visitors to stop and look. In addition, paths should provide some freedom of choice of direction. Price's recommendations in the category of programming were for gardens to provide in-garden demonstrations that would enhance the garden visit experience and provide in depth information, as well as to organize special events to draw the public in and provide more information about gardening topics than possible through the exhibits alone.

Falk & Dierking (2000), Serrell (1996), and Wandersee & Clary (2007) each point out the need to tap into prior knowledge of visitors to design effective educational experiences. This requires knowing the audience, which is usually accomplished through a visitor study or needs assessment. Undertaking a needs assessment can generate valuable information for planning programs for both non formal and free choice learning and will assist agents with planning programs targeted to their audiences' needs and preferences. Conducting needs assessment and audience targeting are part of the foundation of Extension programming, resulting in the enhanced effectiveness and efficiency of Extension's educational programs (Richardson, n.d.). Needs assessment should aim to discover the values and beliefs, knowledge levels, observed and expressed needs, demographics, preferred delivery methods, past experiences, and other information necessary to guide program development for identified audiences (Richardson, n.d.). This information is also needed for developing educational goals and defining learning outcomes necessary to conduct evaluation, which will provide valuable feedback on program effectiveness.

Other Program Benefits

Demonstration gardens can provide additional benefits to horticulture programs beyond their value as educational delivery methods to enhance non formal education efforts and enable free choice learning. Establishment of collaborations and partnerships and the utilization of volunteers to extend educational reach have both been identified as sources of excellence for Extension (Archer, Warner, Miller, Clark, James, Cummings, & Adamu, 2007). Demonstration gardens can be the catalyst necessary to create meaningful community collaborations and form lasting, mutually beneficial partnerships with commercial and non-profit organizations (Renquist, 2005). Because of their visual appeal, demonstration gardens can draw individuals to programs, serving as an asset to volunteer recruitment (Wilson, Minton, Mecca, Gersony, 2004). Master Gardeners are trained volunteers who assist horticulture agents with the delivery of educational programs. Studies have shown that individuals joining the Master Gardener program anticipate being involved with landscape and demonstration gardening projects as a form of community involvement (Mayfield & Theodori, 2006). Opportunities to learn, hands-on instruction, and opportunities to contribute to community development have been identified as benefits of being in the Master Gardener program by volunteers (Schrock, Meyer, Ascher, & Snyder, 2000), indicating that the development of demonstration gardens would be a good fit to provide volunteer opportunities for these volunteers.

Summary

As a modified form of the on-farm test, demonstration gardens can be a valuable educational delivery method for Extension horticulture programs. Because of their concrete and tangible nature, demonstration gardens provide excellent experiential learning opportunities that can be used to enhance non formal education efforts such as classes and workshops. Multiple environmental and horticultural education goals can be addressed through demonstration gardens, including water conservation, storm water management, correct plant selection, and wildlife habitat creation. Youth, homeowners, volunteers, and green industry professionals can benefit from programs that utilize demonstration gardens to increase participant’s knowledge, enhance skills, and change attitudes and aspirations. By developing educational materials that focus on a main theme, agents can also employ demonstration gardens as tools for free choice learning for Extension clients. Utilizing non formal and free choice learning opportunities that can occur in demonstration gardens will enhance agents’ abilities to implement programs that have lasting environmental, social, and economic impacts. In addition, demonstration gardens can serve as the catalyst for developing long term, mutually beneficial community collaborations and partnerships, as well as increase volunteer involvement, promote leadership development, and enhance the overall volunteer experience.

CHAPTER 3: METHODS AND PROCEDURES

The purpose of this study was to investigate how horticulture Extension agents in North Carolina utilize demonstration gardens as teaching tools in their Extension education programs. In addition, this study identified features, techniques, and practices that agents are incorporating into demonstration gardens to enhance educational effectiveness. More specifically, the study answered the following research questions:

1. What are the characteristics of demonstration gardens currently utilized by North Carolina horticulture Extension agents?
2. How are horticulture agents in North Carolina utilizing demonstration gardens in their Extension education programs?
3. Which audiences are targeted?
4. What features, techniques, and practices are employed by agents to enhance the educational effectiveness of demonstration gardens for self directed learning?
5. What are the challenges of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?
6. What are the benefits of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?
7. What competencies do North Carolina horticulture Extension agents require to develop, maintain, and utilize demonstration gardens as an educational delivery method for Extension horticulture programming?

This chapter describes the research design, population studied, instrument development, data collection procedures, instrument reliability, and data analysis.

Research Design

A descriptive research design was chosen for this study to allow for a wide scope of information to be collected about the characteristics of the demonstration gardens currently utilized by North Carolina horticulture agents and their perceptions of the benefits, values, and competencies required when employing gardens as an educational delivery method. Descriptive research allows the researcher to summarize the characteristics and attitudes of a population by asking them questions and deriving data from the answers gathered (Fraenkel & Wallen, 2006). Quantitative data were gathered from North Carolina horticulture agents through a two part survey.

A telephone survey was designed to acquire information about the characteristics of Extension demonstration gardens. Descriptive data were collected about each garden, including its size, location, plant composition, partnerships involved, funding sources, and volunteer involvement. In addition, a web based survey was used to determine which audiences are targeted and how agents are utilizing gardens in their programs, as well as agents' perceptions of the challenges and benefits of utilizing demonstration gardens, and the competencies needed to develop, maintain, and utilize demonstration gardens as part of an Extension horticulture program. The web survey included three scales developed to determine agent perceptions.

Population and Sampling Procedure

The population of this study was North Carolina Cooperative Extension agents with responsibilities in horticulture who currently have, or formerly had, a demonstration garden as part of their Extension program. The sample included 100% of the population. The population was identified by contacting all North Carolina Extension agents with horticulture responsibilities by email to ascertain which currently have or previously had demonstration gardens. A copy of the initial email message sent is available in Appendix C. A master list of all horticulture agents was created by visiting each county's Extension website to determine the current horticulture agent. Ninety horticulture agents were contacted by email four times over a two month period to invite their participation. Thirty-eight agents responded to the email, three of which formerly utilized gardens, but no longer do, and 35 of which currently utilize gardens. The principal researcher maintains two demonstration gardens as part of her Extension horticulture program in Pender County. These gardens were not included in the study. In addition, at least one county currently utilizing a garden was not able to be included in the study due to the horticulture agent position being vacant.

Instrumentation

Data for this study were gathered through a two part survey. The initial survey was delivered by telephone interview and was composed of mostly close ended questions designed to gather demographic data about demonstration gardens currently being utilized by

North Carolina horticulture Extension agents. The telephone survey instrument is available in Appendix A.

Agents were initially asked if they currently or formerly utilize gardens as part of their horticulture program. Agents who answered formerly were asked why they discontinued use of the garden. This was the extent of their participation in the study. Agents who answered they currently utilize one or more demonstration garden were asked further questions to collect data on the number of gardens they utilize, as well as the name, size, location, plant composition, year of ground breaking, initiator, sources of support, volunteer and Master Gardener involvement, staffing, funding sources, web presence, admission fee, visitation, and hours of operation for each garden. In addition agents were asked the size of their Master Gardener Program, their time commitment to manage the gardens, their future vision for their garden, and their areas of responsibility.

Following the phone survey, each agent currently utilizing demonstration gardens was emailed and asked to participate in a web survey. A copy of the email message they received is available in Appendix D. The web survey instrument is available in Appendix E. This web survey was developed utilizing NCSU's College of Agriculture and Life Science's Survey Builder application. The web based survey asked agents about the ways they are utilizing gardens in their programs, how they are enhancing their non formal educational efforts with the garden, what features, practices, and techniques they are employing to facilitate self directed learning, types of research conducted in the garden, which principles and practices are being demonstrated, which audiences are served, and their evaluation practices related to the garden. The questions included multiple choice answers with the option to indicate other. Agents were asked to select all that apply. The questions in this part of the web survey were derived from a review of the literature.

In addition, the web survey included three scales developed to determine agent perceptions of the challenges, benefits, and competencies related to utilizing demonstration gardens as part of an Extension horticulture program. Each employed a five point Likert scale as follows:

1) Agents were asked to rate their perceptions of the challenges of developing, maintaining, and utilizing demonstration gardens on the following scale: No Impact (1), Very Little Impact (2), Little Impact (3), Some Impact (4), or High Impact (5).
2) Agents were asked to rate their perceptions of the benefits of demonstration gardens on the following scale: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), or Strongly Agree (5).
3) Agent's personal competency levels in relation to developing, maintaining and utilizing a demonstration garden were measured by asking them to rate their desire for training on a variety of topics utilizing the following scale: No Desire (1); Little Desire (2); Moderate Desire (3); High Desire (4); and Very High Desire (5)

Procedures

Data Collection

Data for this study were collected through a two part survey. Data on garden characteristics was collected via phone interviews. Phone interview times were scheduled for agents who responded to the initial email regarding their use of demonstration gardens. Agents were contacted during work hours at their office. A copy of the phone survey instrument was sent to each agent for their review prior to the interview. Answers were recorded in a Word document during the interview. Data from each agent was coded by county name.

Data on garden utilization, principles and practices demonstrated, target audiences, techniques to support self directed learning, evaluation practices, and agents' perceptions were gathered through a web based survey delivered via the internet. Each agent currently utilizing a demonstration garden was emailed a link to the survey and asked to participate. The email seeking participation was sent four times over a six week period.

The target response rate for the phone survey was 100%. To ensure this response rate was achieved, agents were invited by the principle researcher, their colleague, to participate by email multiple times over a two month period. The importance of the study and how its findings could benefit the agent's horticulture program was expressed in the email message. In addition agents participating in the study were asked to identify other county Extension programs known to utilize demonstration gardens.

Validity and Reliability

Validity refers to the extent to which an instrument measures what it is intended to measure. Content validity of the instrument was established by a panel of experts. This panel was made up of the researcher's graduate committee and included two faculty members from North Carolina State University's Department of Agricultural and Extension Education and one faculty member from the Department of Horticulture Science. Face validity of the web survey was established by field testing the instrument among Florida horticulture Extension agents currently utilizing demonstration gardens. No problems were revealed during the field test and no changes were made to the web instrument.

Reliability refers to the degree of consistency that an instrument measures what it measures. Reliability of the scales employed in this study was determined by calculating Cronbach's alpha. Scores for each of the scales were as follows: Challenges, 0.76; Benefits, 0.83; Competencies, 0.86. The reliability coefficient for the challenge scale was found to be in the 0.70 to 0.79 range, which is considered as acceptable or good reliability (Fraenkel & Wallen, 2006). Reliability coefficients for the benefits and competency scales were found to be between 0.80 to 0.89, considered a very good reliability range.

Data Analysis

Phone survey data were coded by county name and entered into an Excel spreadsheet. Web survey data were downloaded into an Excel spreadsheet. Descriptive statistics were used to summarize data. Frequency distribution tables and graphics were generated for demographic data. Scales were analyzed through the calculation of means and standard deviations for each item.

CHAPTER 4: FINDINGS

This chapter presents findings of the study of North Carolina horticulture Extension agents' utilization of demonstration gardens as teaching tools. For the purpose of this study a demonstration garden was defined as a landscape or garden planting designed and maintained under the supervision of a horticulture Extension agent for the purpose of teaching horticultural principles and practices as part of an Extension education program.

All North Carolina horticulture Extension agents were contacted by email and asked if they currently utilize demonstration gardens as part of their horticulture program, or if they have ever utilized demonstration gardens as part of their program. A telephone survey was conducted among agents currently utilizing demonstration gardens to determine the characteristics of these gardens. Agents were asked the number of gardens they utilize; the location, size, and plant composition of each garden; who initiated each garden and when construction began; hours of operation, admission fee, annual visitation, and web presence; how the gardens are supported including sources of funding and the role volunteers play in the gardens' development, management and utilization; number of paid staff; and their goals for the garden and what is needed to accomplish them. The telephone survey instrument can be found in Appendix A.

Following the telephone survey, a web survey was conducted among agents currently utilizing demonstration gardens to determine how gardens are being employed as part of the agent's horticulture education program; which audiences are being targeted; what features, techniques, and practices are being employed in demonstration gardens to enhance their effectiveness for self directed learning; the challenges of choosing demonstration gardens as an educational delivery method; the benefits of choosing demonstration gardens as an educational delivery method; and the competencies required by North Carolina horticulture Extension agents to develop, maintain, and utilize demonstration gardens as an educational delivery method for Extension horticulture programming. The Web survey instrument can be found in Appendix B.

Research Question One:
What are the characteristics of demonstration gardens currently utilized by North Carolina horticulture Extension Agents?

All North Carolina horticulture agents were contacted and asked if they currently utilize demonstration gardens, or if they formerly utilized demonstration gardens, as part of their horticulture program. Thirty-five agents were identified that currently utilize demonstration gardens, while three agents were found to formerly utilize gardens. Agents who formerly utilized gardens were asked why they discontinued this practice, to which each had a different response as follows: 1) "did not have the volunteer force to keep it going" 2) "too much time, not enough benefit"; and 3) "office moved to a new location". It should be noted that the agent who discontinued use of his demonstration garden because of the Extension center relocating plans to create a new demonstration garden at the new site.

Number of Agents, Counties, and Gardens Identified

A total of 34 counties were identified to contain 50 different Extension demonstration gardens, which are being utilized by 35 horticulture agents (Table 1). Eight counties were found to utilize gardens at more than one location. The number of multiple gardens utilized by any one agent ranged from two to four as listed in Table 2. Only one county, Buncombe, was identified as having a demonstration garden utilized by agents from other counties. This garden, The Plant Professional Landscape Garden at the North Carolina Arboretum, is utilized by agents from Buncombe and three surrounding counties to teach plant identification to green industry professionals seeking to become Certified Plant Professionals. A table of the 50 gardens identified can be found in Appendix E.

Table 1

Number of Agents, Counties, and Gardens Identified

Category	#
Horticulture agents participating in study	38
Horticulture agents currently utilizing demonstration gardens	35
Horticulture agents who formerly utilized demonstration gardens	3
Counties with Extension demonstration gardens	34
Extension demonstration gardens	50
Counties with more than one demonstration garden	8
Demonstration gardens utilized by agents from more than one county	1

Table 2

Counties with More than One Demonstration Garden

County	# of Gardens
Buncombe	4
Carteret	4
Moore	4
Pasquotank	3
Wayne	3
Forsyth	2
Polk	2
Wake	2

Location of Counties and Gardens

Thirty-four counties across North Carolina were identified as containing Extension demonstration gardens, literally stretching from the mountains to the sea (Figure 1). Findings show these gardens are being utilized by agents in all three of North Carolina's geographic regions (Table 3).

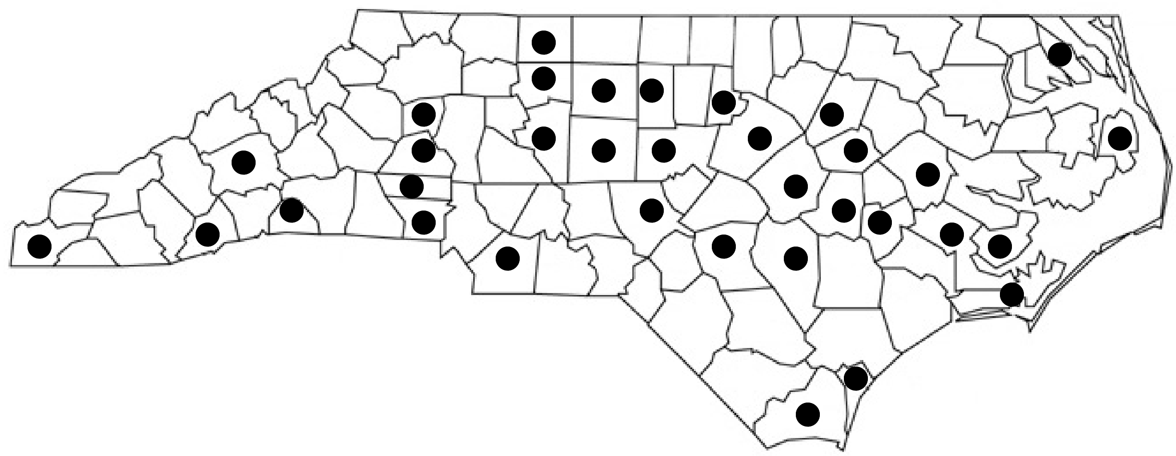

Figure 1

Location of North Carolina Counties Utilizing Demonstration Gardens

Table 3

Location of Counties with Extension Demonstration Gardens by Geographic Region

Region	# of Counties
Coastal Plain	15
Piedmont	15
Mountains	4
Total	34

Population data for counties containing demonstration gardens were obtained from the North Carolina Office of State Budget Management (2010). Population data showed gardens are being utilized by agents in counties with a wide range of populations (Table 4), from a low of 12,838 (Pamlico County) to a high of 892,409 (Wake County). Sixteen counties (47%) have a population of less than 100,000, with half of these (eight counties) having a population of less than 50,000. Eleven counties (32%) have populations ranging from 100,000 to 200,000, while seven counties (21%) have populations over 200,000 people, of which two counties (6%) have populations exceeding 400,000.

Table 4

Population of Counties with Extension Demonstration Gardens

Population	# of Counties	% of Counties
Less than 50,000	8	23.5
50,001 to 100,000	8	23.5
100,001 to 200,000	11	32.4
200,001 to 400,000	5	14.7
Over 400,000	2	5.9
Total	34	100

The 50 gardens identified in this study were found to be located on a variety of properties within each county (Table 5). Twenty-five gardens (50%) were found to be at that county's Extension center, all of which are located on county property. An additional 13 gardens

(26%) were found to be located on a separate county property, of which six gardens (12%), were located within county owned parks. Other county owned properties hosting Extension demonstration gardens included a high school, two Senior Centers, a community college, a courthouse, and a library. Non county properties found to host Extension demonstration gardens included the following state owned properties: the NC Fair Grounds, the NC Aquarium at Pine Knoll Shores, the Western NC Farmer's Market, and the NC Arboretum; as well as nonprofit organizations, which included local museums, environmental education centers, and a food bank. Two gardens were located on privately owned property and only one garden, The Pollinator Paradise Garden in Chatham County, was found to be located on commercial property.

Table 5

Location of Extension Demonstration Gardens

Location	# of Gardens	% of Gardens
Extension Center	25	50.0
County Park	6	12.0
Other County Property	7	14.0
Non Profit Property	5	10.0
State Property	4	8.0
Private Property	2	4.0
Commercial Property	1	2.0
Total	50	100

Among agents that utilize demonstration gardens, 20 maintain gardens at the Extension center only, while five maintain gardens at both the Extension center and at least one other location. Ten agents utilize gardens located only on properties other than the Extension center. When asked why these agents chose to develop gardens on a site away from the Extension center all indicated at least part of the reason was related to location – either land was not available at the Extension center, the Extension center was not located in a heavily trafficked area, or the Extension center was not located in an area convenient for the target audience. One agent noted that she “put a lot of thought into the sites” and “chose public locations that already had a large audience”. In addition, she also chose sites “that could provide water and the opportunity to develop relationships”.

Garden Initiation and Year of Ground Breaking

For each garden, agents were asked who initiated the development of the garden. Forty-two percent were found to be initiated by the current horticulture Extension agent. Twenty-four percent were initiated by a previous horticulture Extension agent and are now being continued by the current agent. Five agents (10%) replied the initiation of the garden was a staff effort, involving either the 4-H agent or family consumer sciences agent, or both. Another five agents (10%) reported the garden was initiated by a Master Gardener Volunteer or group of Master Gardeners, while four gardens (8%) were found to be initiated by their county government approaching Extension and asking them to manage or landscape the site. Two of these gardens are located at county Extension centers, while the other two are located on other county properties. In three cases, the gardens were initiated when the host site approached Extension and asked if they would be willing to partner with them by creating a demonstration garden at their location. One of these gardens, The Plant Professional Landscape Garden, was co-initiated by the host site, The NC Arboretum, approaching Extension as well as Extension clientele (green industry professionals) asking for the garden to be developed.

Table 6

Parties Responsible for Initiating Extension Gardens

Initiated by	# of Gardens	% of Gardens
Current Horticulture Agent	21	42.0
Former Horticulture Agent	12	24.0
Extension Staff	5	10.0
Master Gardener Volunteer	5	10.0
County	4	8.0
Host Site	3	6.0
Total	50	100

Agents were asked when actual construction, or ground breaking, for each garden began (Table 7 and Figure 2). Construction of 66% of these gardens (33 of 50 gardens) began within the last ten years, with 36% (18 gardens) beginning construction since 2006. Of these, construction of four gardens began in the current year, 2010. Thirty-four percent, or 17 gardens, were found to be at least ten years old, with construction starting in 2000 or before. Of these, the garden found to be in operation for the longest time was the New Hanover County Arboretum, for which construction began in 1985, followed by the demonstration garden at the Craven County Extension Center, for which construction began in 1989.

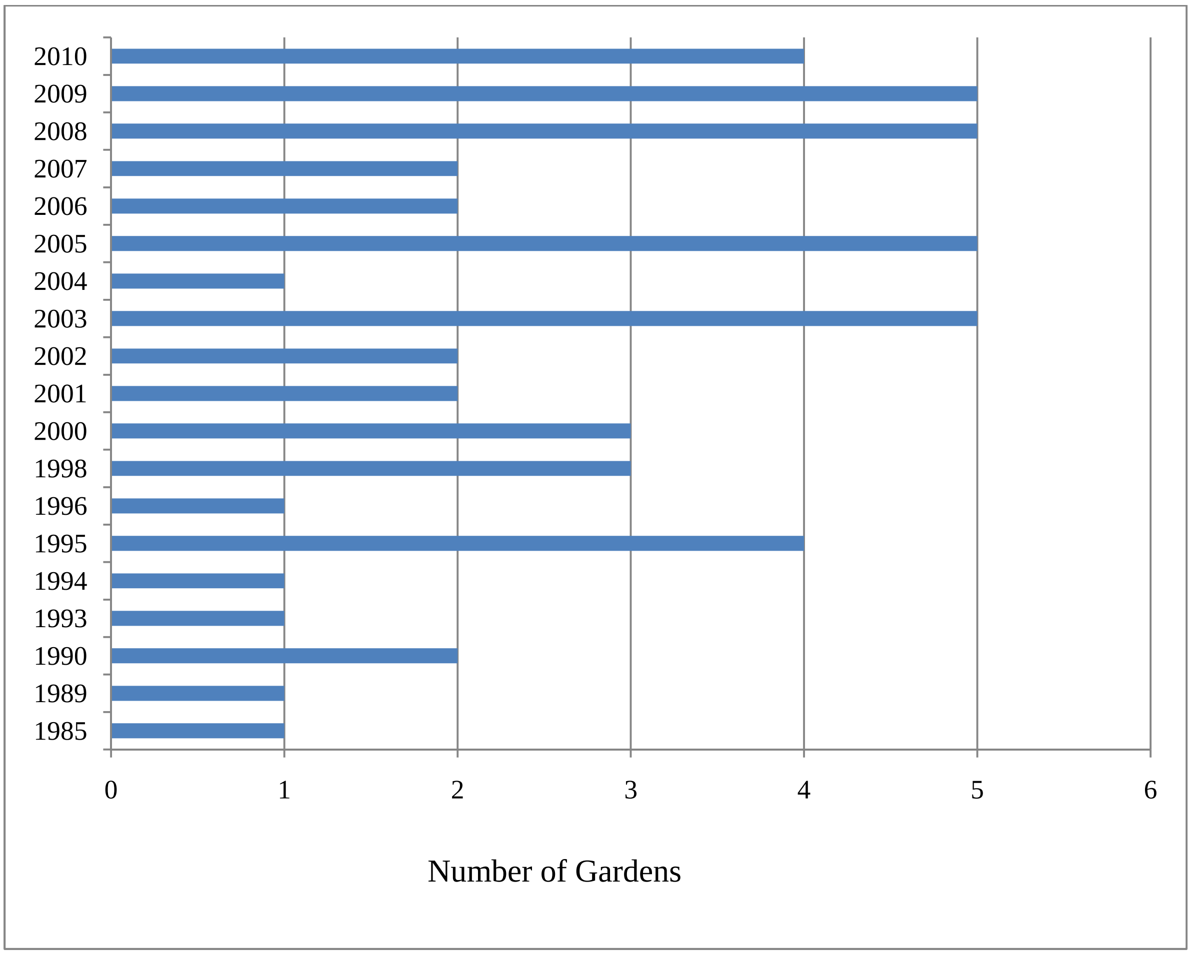

Figure 2

Ground Breaking Year of Extension Demonstration Gardens, N=50

Table 7

Ground Breaking Year of Extension Demonstration Gardens

Year	# of Gardens	% of Gardens
2006 – 2010	18	36.0
2001 – 2005	15	30.0
1996 – 2000	7	14.0
1991 – 1995	6	12.0
1986 – 1990	3	6.0
1981 – 1985	1	2.0
Total	50	100

Garden Size and Plant Composition

Agents were asked the size and plant composition of each garden. Size was recorded based on the amount of area currently developed, not the total amount of area available (Table 8 and Figure 3). Garden sizes spanned a wide range. The smallest garden identified was 50 square feet, a raised bed vegetable garden in Lincoln County. The largest was 33 acres. This garden, located at a high school in Polk County, is used to showcase native and adapted tree species, hedge species, and shrubs suitable for that county's growing conditions. The garden is maintained by the horticulture Extension agent and utilized for Master Gardener training as well as for high school agriculture classes taught by the school's agriculture education teacher.

The majority of gardens were found to fall within the size range of either less than 1000 square feet, which was true for 12 gardens (24%), or from 1000 to 5000 square feet, true for 14 gardens (28%). Seven gardens (14%) fell within the size range of 5001 sq. ft. to 0.50 acre (21,780 sq. ft.) , while six (12%) ranged from 0.51 acre to 1.5 acres. An additional seven gardens (14%) were found to be between 1.51 to 5.0 acres in size, though only four gardens (8%) exceeded 5.0 acres. The largest of these, the 33 acre Arboretum in Polk County, is mentioned above. The remaining three are: The Arboretum at Tanglewood, 8 acres, Forsyth County; The New Hanover County Arboretum, 7 acres, New Hanover County; and The Wilson Botanical Gardens, 6 acres, Wilson County.

Table 8

Size of Extension Demonstration Gardens

Size	# of Gardens	% of Gardens
Less than 1000 sq. ft.	12	24.0
1000 to 5000 sq. ft.	14	28.0
5001 to 0.5 acre	7	14.0
0.51 to 1.5 acres	6	12.0
1.51 to 5.0 acres	7	14.0
Over 5.0 acres	4	8.0
Total	50	100

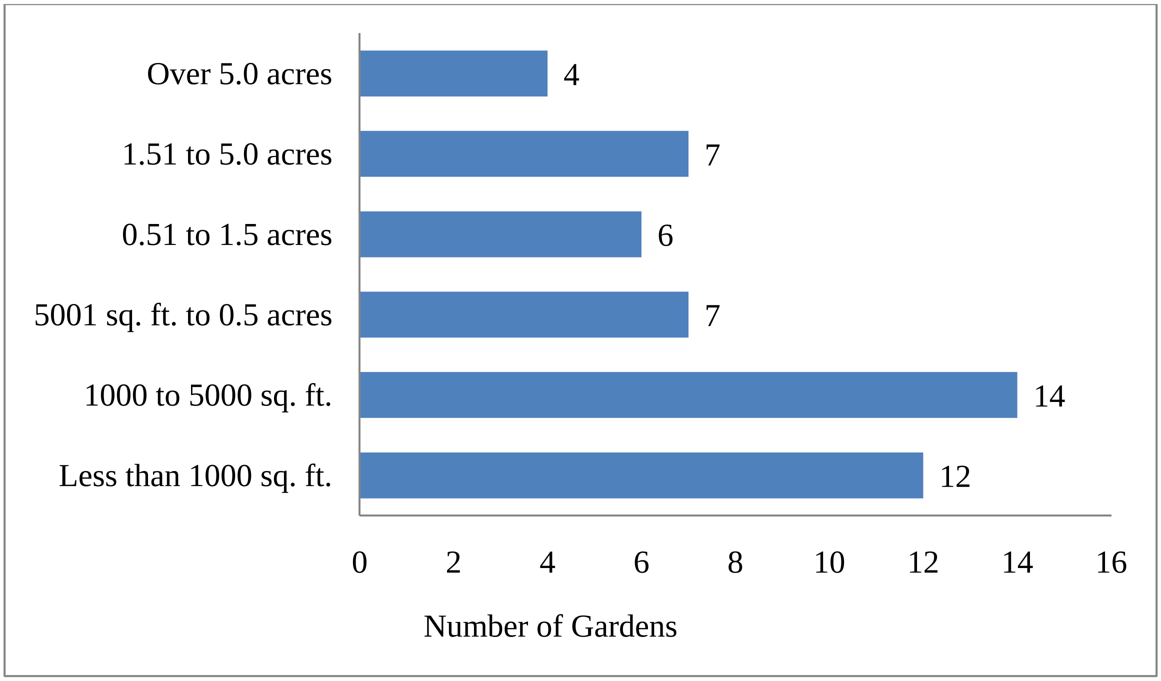

Figure 3

Size of Extension Demonstration Gardens, N=50

Agents were asked what types of plants are grown in each garden. The plant composition of each garden was categorized as follows:

- Edible Only = Gardens containing only vegetables, culinary herbs or fruit bearing trees and shrubs.
- Ornamental Only = Gardens containing only plants grown for their ornamental value. These could include annuals, perennials, bulbs, ornamental grasses, groundcovers, shrubs, trees, and turf grasses.
- Mixed = Gardens containing both edible and ornamental plants.

The highest number of gardens were found to be composed of mixed plantings of both edible and ornamental plants. This was true for 23 gardens (46%). Seventeen gardens (34%) were planted in ornamental plants only, while 10 gardens (20%) were composed of edible plants only (Table 9).

Table 9

Plant Composition of Extension Demonstration Gardens

Type of Plantings	# of Gardens	% of Gardens
Mixture of ornamental and edible plants	23	46
Ornamental plants only	17	34
Edible plants only	10	20
Total	50	100

Gardens were categorized by plant composition and garden size. The smallest group of gardens was found to be the edible only gardens, with only one of these gardens exceeding 5000 square feet, the 0.5 acre Community Garden in Cherokee County. Ornamental only and mixed planting gardens were found to occupy a wide range of sizes. Like the edible only gardens, the majority of ornamental gardens fell within the range of less than 5000 sq. ft., while mixed gardens were found to be more evenly distributed over all size ranges. See Table 10.

Table 10

Type of Extension Demonstration Garden by Size

Size	Edible	Ornamental	Mixed	Total
Less than 1000 sq. ft.	6	4	2	12
1000 to 5000 sq. ft.	3	6	5	14
5001 sq. ft. to 0.5 acre	1	1	5	7
0.51 to 1.5 acres	0	1	5	6
1.51 to 5.0 acres	0	4	3	7
Over 5.0 acres	0	1	3	4
Total	10	17	23	50

Gardens were also categorized by plant composition and year of initial construction. The youngest group of gardens was found to be the edible only gardens, with only one of these gardens exceeding ten years in age, the Manna Food Bank Vegetable Garden in Buncombe County. Eight of the 10 edible only gardens were found to be established in just the last five years, with three of them breaking ground in the current year, 2010. Both ornamental only and mixed gardens were found to have been established over a wide range of years, though the two oldest gardens, The New Hanover Arboretum (1985) and the demonstration garden at the Craven County Extension Center (1989) contain mixed plantings. See Table 11.

Table 11

Type of Extension Demonstration Garden by Year Started

Year	Edible	Ornamental	Mix	Total
2006 – 2010	8	5	5	18
2001 – 2005	1	6	8	5
1996 – 2000	1	1	5	7
1991 – 1995	0	4	2	6
1986 – 1990	0	1	2	3
1981 – 1985	0	0	1	1
Total	10	17	23	50

Hours of Operation, Admission, Visitation, and Web Presence

Additional demographic information collected about each garden included the gardens' hours of operation, admission cost, annual visitation in 2009, and if the garden had any presence on the Web. Only seven gardens were found to have posted hours outside of daylight hours or sun up to sun down. All seven of these gardens are located on sites other than the Extension center and adhere to the hours of operation of the host site. One garden, the Kinston/Lenoir County Children's Garden located at a county operated park, is open only during programs or by special arrangement.

Though four gardens were found to be located on properties that have some type of paid admission, they are developed in areas where admission is not required to view the gardens. Only three gardens were found to require paid admission to view the gardens. All three of these gardens are located on properties other than the Extension Center that require paid admission to enter their grounds. These gardens are located at: 1) the NC Arboretum, which charges an $8 parking fee to visitors; 2) the Western NC Nature Center, which charges a $2 admission fee; and 3) Tanglewood Park in Forsyth County, which also charges a $2 admission fee. For the gardens at Tanglewood Park and the Western NC Nature Center, agents have arranged to have the admission fee waived for clients participating in Extension programs held at that site. The Plant Professional Landscape Garden located at the NC Arboretum is utilized to train green industry professionals to become Certified Plant Professionals. The agents who offer this training charge a fee for the course, into which they include the cost of an annual membership to the NC Arboretum, allowing participants to visit the garden when needed over the duration of the course without having to pay the $8 parking fee each time.

Few agents were able to provide visitation data for their gardens. Those that did provide estimates varied in their method of collecting these numbers. Some counted all individuals who visited that property over the course of the year, whether they came to see the gardens or for some other reason. Others counted only those that participated in programs that utilized the gardens. Because of these inconsistencies, the decision was made not to report visitation data.

Fourteen of the 50 gardens were found to have some type of presence on the Web, whether it was a page on the county Extension center’s Website, a page or entry on their host property’s Website, or their own site. Only two gardens were found to have their own

Websites, The Arboretum at Tanglewood and the Pollinator Paradise Garden located in Chatham County, with only one site (Pollinator Paradise) containing educational information related to the garden.

Garden Support

Information was collected from each agent who currently utilizes demonstration gardens on how the garden's development, maintenance, and utilization are supported. For the purpose of this study support was defined as funding, donations of materials or services, and/or volunteer service. More in depth information was collected on sources of funding, volunteer involvement in the gardens, and the establishment of support groups.

Support. Agents were asked to list all sources of support for their garden(s) and categorize them as either one time, occasional, or ongoing. Fifteen categories of supporters were identified (Table 12). The source of support identified most frequently was Master Gardener Volunteers, identified 31 times. This source was also most frequently identified as an ongoing supporter of Extension demonstration gardens, recognized by 26 of 35 agents as an ongoing supporter of their garden(s). The ways Master Gardener Volunteers were found to support Extension demonstration gardens are reported later in this chapter.

Garden centers and nurseries were the second most frequently identified source of support, identified by 24 of 35 agents as providing support for their garden(s), most commonly in the form of plant donations. Garden centers and nurseries were the most frequently identified provider of occasional support.

County government was the third most frequently identified source of support, named by 22 agents. They were also the second most frequently identified provider of ongoing support, usually in the form of providing land for the garden; assistance with garden maintenance, particularly mowing; use of equipment; and funding.

Garden clubs and landscape service companies were both identified by 12 agents as supporters of their garden(s). Garden clubs were more often named as occasional supporters, and described as providing monetary donations, whereas landscape service companies were identified equally among the three categories of one time, occasional, and ongoing. The most common type of support provided by landscape service companies was donations of materials and services, including labor during garden installation and lawn maintenance.

4-H volunteers and businesses other than garden centers and nurseries were both identified by nine agents as a source of support. 4-H was most likely to provide support on an occasional basis, usually as labor to help with garden maintenance, whereas businesses were the most frequently identified provider of one time support, donating either materials or money to the garden.

Host sites were identified by all eight counties maintaining gardens on properties other than the county Extension center as providers of ongoing support, providing land and in many cases assisting with garden maintenance and occasionally providing funding for the garden. Youth organizations (other than 4-H) were also identified by eight agents as garden supporters, most frequently as occasional supporters. Most of this type of support involved Boy Scout or Eagle Scout projects.

City or town municipalities, civic clubs and community colleges were each identified by six agents as garden supporters. Civic clubs were most commonly cited as one time or occasional providers of funding. Community colleges were cited at equal frequency as providers of one time or occasional support, examples of which include class projects that assisted the garden.

The least frequently identified supporters of Extension demonstration gardens were private citizens, nonprofit organizations, and high schools, each of which were identified by five agents. Nonprofit organizations were most frequently cited as providing support in the form of funding on an occasional or ongoing basis, whereas high schools most frequently provided occasional support through student assistance with garden development and maintenance. Private citizens were cited as ongoing supporters of three gardens, providing funding for two gardens and ongoing volunteer services for another.

Table 12

Sources of Support for Extension Demonstration Gardens, N=35

Source	One Time	Occasional	Ongoing	Total Occurrences
Master Gardener Volunteers	0	5	26	31
Garden Centers and Nurseries	1	18	5	24
County Government	2	2	18	22
Garden Clubs	1	8	3	12
Landscape Service Companies	4	4	4	12
4-H Volunteers	1	6	2	9
Businesses	6	3	0	9
Host Sites	0	0	8	8
Youth Organizations	1	6	1	8
City or Town	2	0	4	6
Civic Clubs	2	3	1	6
Community College	2	3	1	6
Private Citizens	1	1	3	5
Non Profit Organizations	1	2	2	5
High School	0	4	1	5

Support Groups. Agents were asked if they had established any structured groups at the county level to support their garden's development, maintenance, and/or utilization (Table 13). Structured groups include advisory groups or committees formed specifically in support of the garden(s). Many agents stated they had established advisory groups for their horticulture program, though only nine of the 35 agents interviewed had established an advisory committee dedicated to their demonstration garden. Agents were found to have more commonly established volunteer committees or teams dedicated to the maintenance, development, or educational use of the gardens, with 24 agents (69%) having established such a committee. Two agents reported the establishment of a foundation with a board of directors in support of their garden, particularly financially. Foundations had been established for the Wilson Botanical Gardens and New Hanover County Arboretum.

Table 13

Support Groups Established at County Level for Demonstration Gardens

Type of Group	# of Agents *N* = 35	% of Agents
Volunteer Committee or Team	24	69
Extension Advisory Committee	9	26
Foundation	2	6

Funding. Agents were asked to identify sources of funding for the development, maintenance, and utilization of their demonstration gardens (Table 14). The most frequently identified funding source was their Master Gardener Program, cited by 22 agents (63%). Many agents stated that their Master Gardener Program made regular contributions to the garden, raising funds through plant sales, cookbook sales, or other activities. The second most frequently identified source of funding was grants, cited by 12 agents (34%), though these funds were usually of a onetime nature rather than ongoing. County government was the third most frequently identified funding source, cited by 11 agents (31%), who stated their counties provided funds either as part of their annual Extension budget in a grounds line item, or in a few counties provide a line item specifically for the garden by name.

Extension or agent funds were identified by seven agents (20%) as sources of garden funding. These included funds generated by agents, such as fees taken in for classes or speaker's honorariums, or funds held at the county level for the entire Extension program. Donations by individuals or businesses were cited by six agents (17%) as sources of funding.

Garden specific fundraisers, paid memberships, and host site contributions were each identified by three agents (9%) as sources of garden funding. Garden specific fundraisers included commemorative brick programs, garden tours, and plant sales. Three gardens, The Wilson Botanical Gardens, The New Hanover Arboretum, and The Pitt County Arboretum, have established paid membership programs known as "Friends" programs. In addition to supporting the garden, "Friends" members get benefits such as discounts at local garden centers who have agreed to participate, invitations to special "Friends Only" events, and garden newsletters. One garden was found to receive funding from a programming partner. This garden, The Taylorsville Learning Center Community Garden, was initiated to support nutrition education programming for second through fifth graders at a local elementary school. The school is able to provide some funding for the garden, which is located at the county Extension center, from their after school funds.

Table 14

Sources of Funding for Extension Demonstration Gardens

Source	# of Agents *N*=35	% of Agents
Master Gardener Program	22	63
Grants	12	34
County	11	31
Extension or Agent Funds	7	20
Donations	6	17
Fundraisers Specifically for Gardens	3	9
Paid Memberships	3	9
Host Site	3	9
Programming Partner	1	3

Volunteers. Information on volunteer involvement in Extension demonstration gardens was collected (Table 15). Agents were asked if volunteers were involved in any aspect of the garden's development, maintenance, and/or utilization. Thirty-four agents (97%) responded yes. Only one agent responded that volunteers were not involved in any aspect of the garden. Agents responding yes were asked to categorize the frequency of volunteer involvement as either regular or irregular. Twenty-nine agents (85%) responded that volunteers were involved on a regular basis, while 5 agents (15%) responded volunteers were involved on an irregular basis.

Table 15

Volunteer Involvement in Extension Demonstration Gardens, N=35

Category	# of Agents Reporting
Volunteers involved in garden development, management, and/or utilization	34
Volunteers not involved in any aspect of garden	1
Frequency of Volunteer Involvement	
Irregularly	5
Regularly	29

Agents utilizing volunteers were asked to identify the affiliation of volunteers helping with their Extension demonstration garden. Thirty-one agents identified their main volunteer force as Master Gardeners. Three agents did not utilize Master Gardeners, but instead identified their volunteers as having the following affiliations: 4-H (1 agent), green industry (1 agent), and local citizens (1 agent). Agents utilizing Master Gardener Volunteers were asked to identify the roles these volunteers play in their garden's development, maintenance and utilization by the categories listed in Table 16. The three most frequently identified roles of Master Gardeners were: 1) "Maintain Plantings", reported by 97% of agents; 2) "Install Plantings", 90%; and 3) "Fundraising", 81%. One agent noted she "will continue to develop the garden as the volunteer force is available" and "in a way that can be sustainably managed by Master Gardeners so I do not get more than I can take of".

Additional roles Master Gardeners were found to play in support of Extension gardens were: “Design Plantings”, reported by 77% of agents; “Leading Tours”, 65%; “Lead Demonstrations in the Garden”, 61%; and “Publicity and Marketing”, 52%. The least common role Master Gardeners were found to play was the development of materials (handouts, brochures) for use in the garden, occurring in only 32% of counties.

Table 16

Role of Master Gardener Volunteers in Extension Demonstration Gardens

Volunteer Role	# of Counties *N*=31	% of Counties
Maintain Plantings	30	97
Install Plantings	28	90
Fundraising	25	81
Design Plantings	24	77
Lead Tours	20	65
Lead Demonstrations in the Garden	19	61
Publicity and Marketing	16	52
Develop Materials for Use in the Gardens	10	32

To gain an understanding of the scope of Master Gardener Volunteer involvement in Extension demonstration gardens, Master Gardener volunteer roles as identified in Table 16 were divided into four categories as follows:

- <u>Physical Aspect of Garden</u> = design plantings, install plantings, maintain plantings

- Fundraising
- Publicity and Marketing
- Educational Utilization = lead tours, lead demonstrations in the garden; develop materials for use in the gardens.

For each county utilizing Master Gardeners, their volunteer roles were tabulated into these categories. The results are listed in Table 17. Twenty-three percent of agents were found to utilize Master Gardeners in only one category, the physical development and maintenance of the garden. Thirteen percent were utilizing Master Gardens in two categories, the physical aspect and fundraising. The majority of agents (65%) were found to be utilizing Master Gardeners in all four areas, physical, fundraising, publicity and marketing, and educational utilization.

Table 17

Scope of Master Gardener Involvement in Extension Demonstration Gardens

Category	# of Agents Reporting	% of Agents Reporting
Physical aspect only	7	22.5
Physical and Fund Raising	4	13.0
All areas	20	64.5
Total	31	100

Agents utilizing Master Gardener Volunteers in their Extension demonstration gardens were asked how many active volunteers are enrolled in their Master Gardener Program for the current year (2010). Active Master Gardeners are defined as those who have signed a Certification of Agreement for the current year pledging a certain number of volunteer hours (20 hours per year in most counties). The number of active Master Gardener Volunteers was found to range from 11 to 260. The most common range was found to be 25 – 49 and 50 – 74, each occurring in 29% of counties with demonstration gardens. See Table 18.

Table 18

Number of Active Master Gardener Volunteers in Counties Utilizing Master Gardeners in the Development, Maintenance, and Utilization of Demonstration Gardens.

# Master Gardener Volunteers	# of Counties	% of Counties
Less than 25	3	9.7
25 – 49	9	29.0
50 – 74	9	29.0
75 – 99	3	9.7
100 – 149	3	9.7
150 – 199	2	6.5
200 or more	2	6.5
Total	31	100

Staff. For each garden, agents were asked if staff members had been hired specifically for the development and maintenance of the garden. This was found to have taken place in only three counties, New Hanover (2 full time positions), Brunswick (1 full time position), and Forsyth (1 part time position). Agents were then asked to estimate how much time per month they averaged spending working with their garden, to include fundraising, developing and maintaining the garden, managing garden volunteers, and seeking resources for the garden, but not including time spent utilizing the garden educationally (teaching classes, leading tours, developing online or print materials for use in the garden). Time commitments were divided into 10 hour increments as listed in Table 19. The most frequently indicated average monthly time commitment was 1 to 10 hours, cited by 46% of agents, followed by 11 to 20 hours, which was indicated by 33% of agents. Only 21% of agents responded that they spent in excess of 20 hours per month working with their demonstration garden. The two highest average monthly time commitments were from New Hanover County (85 hours per month), and Forsyth County (over 160 hours per month).

Table 19

Average Monthly Agent Time Commitment to Manage Demonstration Garden

Hours	# of Agents	% of Agents
1 to 10	15	46
11 to 20	11	33
21 to 30	3	9
31 to 40	1	3
41 to 80	1	3
81 to 160	1	3
Over 160	1	3
Total	33	100

Agents were asked what areas of responsibility they covered. Ten agents (29%) responded they covered both consumer and commercial horticulture, while an additional ten agents (29%) indicated they cover horticulture plus additional areas, which included field crops, foresty, and pesticide education. Six agents (17%) were found to cover consumer horticulture only, while only one commercial horticulture agent was found to currently utilize a demonstration garden as part of their horticulture program. Eight agents (23%) were found to be serving as the County Extension Director for their county Extension office in addition to having horticultural responsibilities.

Table 20

Horticulture Agent Areas of Responsibility

Area of Responsibility	# of Agents	% of Agents
Consumer and Commercial Horticulture	10	28.57
Consumer Horticulture Only	6	17.14
Commercial Horticulture Only	1	2.85
Horticulture plus County Extension Director	8	22.85
Horticulture plus Other Areas	10	28.57
Total	35	100

Goals and Needs

To gain a sense of the goals horticulture Extension agents have for their demonstration gardens, each agent currently utilizing a garden was asked what their vision is for the future of the garden and what they would need to accomplish this vision. Responses were recorded and divided into like categories. Eight categories were determined for agent goals as listed in Table 21. The highest number of responses fit into the category of increasing the educational effectiveness of the garden, identified by 73% of agents responding to this question. The most common response that fit into this goal was to increase the number of plant identification labels and interpretive signs in the garden, though less specific responses such as “developing somewhere I can go out with classes and identify plants and work together to solve problems” and “creating a space where people can learn hands on” were also included in this category. Fifty-eight percent of agents identified the desire to expand the garden as part of their future vision, while 21% aim to increase public awareness and utilization of the site.

Less common goals included making improvements to the existing garden, cited by 15% of agents, achieving financial stability, building facilities, and increasing community involvement, each of which was identified by three agents (9%). Only one agent cited the desire to conduct meaningful research as a goal for the garden, though this was this agent's primary goal, specifically to trial new plants to test their suitability for local growing conditions.

Table 21

Horticulture Agents' Goals for Demonstration Gardens

Goal	# of Agents *N*=33	% of Agents
Increase Educational Effectiveness	24	73
Expand Gardens	19	58
Increase Public Awareness of Gardens	7	21
Make Improvements to Existing Plantings	5	15
Achieve Financial Stability	3	9
Build Facilities	3	9
Increase Community Involvement	3	9
Conduct Meaningful Research	1	3

Responses to the question, "What would you need to achieve this vision" fell into four main categories, as listed in Table 22. "More Time" was cited by 21% of agents as necessary to realize their vision, while “Money” was cited by 42%. By far though, the most important resource agents identified as necessary to achieve their vision was “Committed Volunteers”, cited by 67% of agents. As part of his response to this question one agent stated, “Money is nice but people are more important. If we have the people we can get the money”, while another noted “once you start a garden you have to make sure you are going to have people there to take care of it”.

Table 22

Resources Identified by Agents as Needed to Achieve Goals

Resource	# of Agents *N*=33	% of Agents
Committed Volunteers	22	67
Money	14	42
More Time	7	21
Pass Zoning/Permitting Requirements	3	9

Research Question Two:
How are horticulture agents in North Carolina utilizing demonstration gardens in their Extension education programs?

North Carolina horticulture Extension agents currently maintaining demonstration gardens were asked to participate in a web survey designed to discover how agents are utilizing these gardens as part of their Extension program. Additional questions on the survey were asked to discover how agents are utilizing gardens to enhance their educational efforts, which principles and practices are being demonstrated, types of research conducted in gardens, and evaluation practices of agents utilizing demonstration gardens.

Demonstration Garden Utilization

Nine categories of garden utilization were identified, as listed in Table 23. Agents were asked to indicate all of the ways in which they are currently utilizing demonstration gardens. To enhance educational efforts was the most common form of utilization. One-hundred percent of agents participating in the survey indicated that they are utilizing demonstration gardens to enhance their non formal education efforts, such as classes and workshops, while 29 agents (97%), indicated they are employing at least one or more technique to facilitate the self directed learning of garden visitors. Seventy-seven percent of agents indicated they utilize the garden to provide educational opportunities they would not be able to provide if they did not have the garden, such as tours and hands on demonstrations, while 70% of agents utilize the garden when training volunteers.

Following educational forms of utilization, the most common use of gardens by agents was to build partnerships with businesses, county government, nonprofit groups and others, indicated by 20 agents (67%). Next was the use of gardens as a marketing tool to increase awareness of Extension, with 18 agents (60%) indicating this utilization method. Fifty percent of agents are utilizing gardens to conduct research, while less common forms of utilization indicated were to raise funds, indicated by 43% of respondents, and to recruit volunteers, 40%.

Table 23

Agent Utilization of Demonstration Gardens

Utilization	# of Agents *N*=30	% of Agents
To enhance non formal education efforts	30	100
To support self directed learning	29	97
To provide educational opportunities that would not be possible without the gardens.	23	77
To train volunteers	21	70
To build partnerships	20	67
To market Extension	18	60
To conduct research	15	50
To raise funds	13	43
To recruit volunteers	12	40

Utilization to Enhance Educational Efforts

Non Formal Education Efforts. Five methods of utilizing demonstration gardens in support of non formal education efforts were identified, as listed in table 24. Agents were asked to indicate all of the methods they currently utilize. The top three methods selected were related to use of the gardens to support hands on learning by either 1) involving audiences directly in the garden's maintenance, indicated by 93% of respondents; 2) utilizing the garden during workshops and classes to provide audiences with hands on experience, 90%; or 3) involving audiences directly in the planning and development of the garden, 83%. Other ways agents are utilizing gardens to support non formal education are by leading demonstrations of correct horticultural practices, such as pruning or planting techniques, 73%, and by providing guided tours of the garden, 67% .

Table 24

Garden Utilization in Support of Non Formal Education Efforts

Utilization Statement	Number Indicating *N*=30	Percent Indicating
Audiences are directly involved in the maintenance of the gardens.	28	93
The gardens are utilized during workshops and classes to provide audiences with hands on experience of the subject matter being taught.	27	90
Audiences are directly involved in the planning and development of the gardens.	25	83
Demonstrations of correct horticultural practices are led by the agent or an expert in the garden.	22	73
Guided tours are provided by the agent or a volunteer.	20	67

The number of techniques each agent is utilizing to enhance non formal education was calculated (Table 25). All agents were found to be utilizing at least two methods, with 50% of agents utilizing all five of the methods listed in Table 24. Twenty-seven and 17 percent of agents were found to be utilizing 3 and 4 methods, respectively. The average number of techniques employed by any one agent to enhance non formal education was calculated to be 4.1, or 80% of the possible methods identified.

Table 25

Degree of Garden Utilization to Enhance Non Formal Education

Number of Techniques Utilized	# of Agents Reporting	% of Agents Reporting
1 or No Techniques	0	0.0
2 Techniques	2	6.7
3 Techniques	8	26.7
4 Techniques	5	16.7
5 Techniques	15	50.0
Total	30	100

Facilitation of Self Directed Learning. The following nine feature, practices, and techniques that can be employed in educational gardens to facilitate self directed learning of garden visitors were identified in the web survey:

- Plants are labeled for identification.
- Gardens are developed around an education theme.
- Paths are constructed through the gardens to allow visitors access to the plantings.
- Seating areas are provided to give visitors a place to study and reflect.
- Plantings are designed to be in scale with home landscapes.
- Interpretive signage is placed in the gardens to enhance visitor understanding and learning.
- A self guiding tour brochure is available in the gardens.
- Brochures on gardening topics are available in the gardens.
- Reference materials available online are promoted in the gardens to encourage continued learning based on the garden visit experience.

Agents were asked to indicate all that they employ in their garden. Results for this question are listed in Table 34 under the findings for research question 4. The number of techniques each agent was found to employ to facilitate self directed learning was calculated (Table 26). The degree of utilization of techniques to facilitate self directed learning was found to be more variable than the degree to which agents are utilizing gardens to enhance their non formal education efforts. One agent was found to be using no techniques to facilitate self directed learning while only 2 agents (7%), were found to be using all nine techniques. The average number of techniques calculated to be used by any one agent was 4.7, only half of the identified possibilities.

Table 26

Degree of Garden Utilization to Facilitate Self Directed Learning

Number of Techniques Utilized	# of Agents Reporting *N*=30	% of Agents Reporting
No Techniques	1	3
1 Technique	3	10
2 Techniques	1	3
3 Techniques	5	17
4 Techniques	4	13
5 Techniques	4	13
6 Techniques	4	13
7 Techniques	5	17
8 Techniques	1	3
9 Techniques	2	7

Principles and Practice Demonstration

Fifteen principles and practices agents were likely to incorporate into their gardens were determined, as listed in Table 27. Agents were asked to identify all of the principles and practices from this list that they currently demonstrate in their garden. “Food Production” was found to be the most frequently indicated principle or practice currently demonstrated in Extension gardens (83%). This was followed by “Water Wise Use/Xeriscaping, and/or Drought Tolerant Plants”, practices aimed at conserving water in the landscape based on plant selection and placement, and “Plant Selection for Site Conditions”, both of which were indicated as being demonstrated in the gardens of 59% of respondents. “Composting” and

"Use of Native Plants in the Landscape" tied as the third most frequently demonstrated principle or practice, both occurring in the gardens of 52% of respondents.

Principles and practices demonstrated in the gardens of less than 50% but more than 30% of respondents were: "Creating Wildlife Habitat", including butterfly and pollinator gardens, indicated by 45%; "Efficient Irrigation Methods" and "Storm Water Management" practices such as rain gardens, rain barrels, cisterns, and swales, both indicated by 41%; and "Use of New or Underused Plants in the Landscape" and "Turf Selection or Turf Variety Demonstrations", both indicated by 31%.

Principles and practices found to be demonstrated less frequently in the gardens of respondents were "Plants on the Certified Plant Professional Exam" and "Landscape Design Principles", both indicated by 28% of respondents; "Technique or Practice Demonstration" such as effects of different pruning methods, indicated by 14%; and "Landscaping for Energy Conservation", indicated by seven percent. The only principle or practice not indicated as being demonstrated in any respondent's garden was "Product Comparison", examples of which include a comparison of different fertilization regimes, mulch comparisons, or comparisons of the efficacy of different pest management practices.

Table 27

Principles and Practices Demonstrated in Extension Gardens

Principle or Practice	# of Gardens *N*=29	% of Gardens
Food Production	24	83
Water Wise Use, Xeriscaping, and/or Drought Tolerant Plants	17	59
Plant Selection for Site Conditions	17	59
Composting	15	52
Use of Native Plants in the Landscape	15	52
Creating Wildlife Habitat	13	45
Efficient Irrigation Methods	12	41
Storm Water Management	12	41
Use of New or Underused Plants in the Landscape	9	31
Turf Selection or Turf Variety Demonstration	9	31
Plants on Certified Plant Professional Exam	8	28
Landscape Design Principles	8	28
Technique or Practice Demonstration	4	14
Landscaping for Energy Conservation	2	7
Product Comparison	0	0

The number of principles and practices demonstrated in each garden was calculated to determine if agents are utilizing Extension demonstration gardens to teach a narrow or wide range of topics (Table 28). While it was determined that the average Extension garden demonstrated 5.7 principles or practices, gardens ranged from demonstrating a single practice or principle (true for two gardens) to a high of 12 different principles or practices demonstrated in a single garden. Twenty-eight percent of agents indicated their gardens demonstrate only one or two principles or practices. These gardens were found to most frequently focus on food production only or a combination of food production and composting. The greatest number of respondents (31%) indicated their gardens demonstrate seven to eight different principles or practices.

Table 28

Number of Principles and Practices Demonstrated Per Garden

Number Demonstrated	# of Agents Reporting *N*=29	% of Agents Reporting
1 to 2 Principles or Practices	8	28
3 to 4 Principles or Practices	3	10
5 to 6 Principles or Practices	4	14
7 to 8 Principles or Practices	9	31
9 to 10 Principles or Practices	4	14
More than 10 Principle or Practices	1	3

Types of Research Conducted

Agents were asked if their gardens were utilized to conduct research. Forty-eight percent responded that no research was conducted, while 52% (15 agents) indicated they did utilize the garden for research. The most common type of research found to be conducted by agents in demonstration gardens was “Plant Trials”, such as to test plant species for suitability to the local climate or growing conditions, performed by 80% of agents conducting research. The second most frequently conducted category of research was found to be “Production Methods or Horticulture Techniques” such as straw bale gardening or alternative training and pruning methods, conducted by 60% of agents. Other categories included “Pest Control Methods, Organic or Conventional”, indicated by 53%, and “Product Testing”, such as testing different formulations of fertilizers, which was the type of research least frequently conducted by agents utilizing gardens for research, indicated by 40%.

Table 29

Categories of Research Conducted in Demonstration Gardens

Category	Number Indicating *N*=15	Percent Indicating
Plant trials	12	80
Production methods/horticultural techniques	9	60
Pest control methods, organic or conventional	8	53
Product testing	6	40

Evaluation Practices

Agents were asked to indicate how they evaluate the impact the garden has on their horticulture program (Table 30). Thirty-four percent responded they do not evaluate the garden’s impact on their program. Twenty-six percent indicated they evaluated the garden’s ability to enhance learning when incorporated into non formal education efforts such as workshops, classes, and tours, while only 21% indicated they evaluate the garden's ability to facilitate self directed learning.

Table 30

Garden Impacts Evaluated by Horticulture Agents, N=29

Evaluation Statement	#	%
I evaluate the garden's ability to enhance learning when incorporated into workshops, classes, tours, and/or training series.	19	66
I do not evaluate the garden's impact on my horticulture program.	10	34
I evaluate the garden's ability to facilitate self directed learning of individuals who visit the garden.	6	21

In response to the question "What methods do you use to evaluate the garden (select all that apply)" the highest percent of agents (52%) indicated "Surveys", while 46% indicated "Interviews" (Table 31). Thirty-two percent of respondents selected "I do not use any evaluation methods". Two agents selected "Other" and specified they use observation as a method of evaluating their demonstration garden.

Table 31

Evaluation Methods Used by Horticulture Agents, N=29

Method	#	%
Surveys	15	52
Interviews	13	46
I do not use any evaluation methods	9	32
Other: Observation	2	7

Research Question 3:
Which audiences are targeted?

Agents were provided a list of audiences commonly served by Extension horticulture programs, as shown in Table 32, and asked to indicate all audiences that are currently served by their demonstration garden. Agents also were given the option of selecting ‘Other’ and specifying audiences not already listed. The audience targeted by the highest percentage of Extension demonstration gardens was found to be home gardeners, served by 97% of agents who responded to this question. This was closely followed by Master Gardener Volunteers, indicated by 93% of respondents. The third most frequently targeted audience was youth, served in 79% of respondent’s gardens. Audiences less commonly served were green industry professionals and teachers, both indicated as being targeted in 31% of respondent’s gardens. Other audiences that agents identified as additionally serving with their demonstration gardens were farmers, the general public, and Parks and Recreation staff.

Table 32

Audiences Served by Extension Demonstration Gardens

Audience	# of Gardens *N*=29	% of Gardens
Home Gardeners	28	97
Master Gardener Volunteers	27	93
Youth	23	79
Green Industry Professionals	9	31
Teachers	9	31

The number of audiences served per garden was determined and found to range from 1 to 6. The average number of audiences targeted was calculated to be 3.4. The highest percent of agents (38%) reported that their gardens targeted three audiences. The most common combination of audiences targeted was found to be Master Gardener Volunteers, home gardeners, and youth, indicated as the audience served by 34% of respondents.

Table 33

Number of Audiences Served Per Garden

Number of Audiences	# of Agents Reporting N=29	% of Agents Reporting
1 Audience	1	3
2 Audiences	5	17
3 Audiences	11	38
4 Audiences	5	17
5 Audiences	5	17
More than 5 audiences	1	3

Research Question 4:
What features, techniques, and practices are employed by agents to enhance the educational effectiveness of demonstration gardens for self directed learning?

Nine features, techniques, and practices employed to enhance self directed learning in a garden setting were identified. Through a web survey, North Carolina horticulture Extension agents currently utilizing demonstration gardens were asked to indicate which of these feature, techniques, and practices they currently employ in their garden to support self directed learning.

Findings are displayed in Table 34. Ninety-seven percent of agents who responded to this question indicated that they employ at least one technique in their garden to support self directed learning. Only one agent indicated that no techniques, practices, or features are employed. All identified techniques, practices, and features were found to be employed by at least some agents. The most frequently employed practice was found to be the use of plant identification labels, indicated by 87% of respondents, followed by the development of gardens around an educational theme, such as water conservation, storm water management, or food production, indicated by 83% of respondents. The installation of paths to allow visitors access to plantings and the provision of seating areas to give visitors a place for reflection and study were indicated as being employed by 67% and 60% of respondents, respectively. Sixty percent of agents responding also indicated that plantings in their gardens were designed to be in scale with home landscape plantings, allowing visitors to more easily gain ideas from the garden for their home landscape space, while 53% of agents responding indicated interpretive signage has been placed in the garden to enhance visitor understanding and learning.

Less commonly employed features, practices, and techniques to support self directed learning of visitors to Extension demonstration gardens were found to be the availability of a self guiding tour brochure, indicated by 33% of agents; the availability of gardening related educational brochures in the gardens, 20%; and the promotion of online resources in the garden to promote further learning based on the garden visit experience, indicated by only 10% of responding agents.

Table 34

Garden Utilization in Support of Self Directed Learning

Utilization Statement	# of Agents Indicating *N*=30	% of Agents Indicating
Plants are labeled for identification.	26	87
Gardens are developed around an educational theme.	25	83
Paths are constructed through the gardens to allow visitors access to the plantings.	20	67
Seating areas are provided to give visitors a place to study and reflect.	18	60
Plantings are designed to be in scale with home landscapes.	18	60
Interpretive signage is placed in the gardens to enhance visitor understanding and learning.	16	53
A self guiding tour brochure is available in the gardens.	10	33
Brochures on gardening topics are available in the gardens.	6	20
Reference materials available online are promoted in the gardens to encourage continued learning based on the garden visit experience.	3	10
No techniques are used to facilitate self directed learning.	1	3

Research Question 5:
What are the challenges of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?

Twelve challenges related to choosing demonstration gardens as an educational delivery method were determined. Through a web survey, North Carolina horticulture Extension agents currently utilizing demonstration gardens were asked to indicate to what extent each of these challenges impacts their ability to develop, maintain, and utilize demonstration gardens. Employing a Likert scale, agents were asked to indicate the impact each challenge had on their ability to develop, maintain and utilize demonstration gardens, as follows: no impact (1), very little impact (2), little impact (3), some impact (4), or high impact (5).

Seven of the 12 challenge statements were found to have an average rating of at least 4.0, “Some Impact”. The challenge found to have the highest impact on horticulture Extension agents’ ability to develop, maintain, and utilize gardens was “Time to manage the gardens” (4.57), followed by “Availability of funds” (4.50). Another time related challenge, “Time to plan and develop the garden” was found to have the third highest rating, (4.43), while “Support of Master Gardener Volunteers” was fourth with an average rating of 4.37. “Availability of volunteers to work in the garden” (4.36), “Availability of land to develop the garden” (4.14), and “Support of the County Extension Director” (4.11), also averaged at the “Some Impact” level.

The challenge found to have the least impact was “Support of Extension administration” (2.93). “Support of county government” (3.57), “Knowledge of techniques to evaluate the garden’s outcomes and impacts” (3.59), “Time to evaluate the garden’s outcomes and impacts” (3.63), and “Community partners who will support the garden” (3.74), were all found to have an average rating between “Little Impact” (3) and “Some Impact” (4) impact. See table 35 for a complete list of challenge statements.

Table 35

Agents' Perceptions of the Challenges of Demonstration Gardens, N=28

Challenge Statement	Mean	SD
Time to manage the gardens.	4.57	0.63
Availability of funding.	4.50	0.64
Time to plan and develop the garden.	4.43	0.79
Support of Master Gardener Volunteers.	4.37	1.08
Availability of volunteers to work in the garden.	4.36	0.91
Availability of land to develop the garden.	4.14	1.11
Support of the County Extension Director	4.11	0.96
Community partners who will support the garden.	3.74	0.98
Time to evaluate the garden's outcomes and impacts.	3.63	1.15
Knowledge of techniques to evaluate the garden's outcomes and impacts.	3.59	1.15
Support of county government.	3.57	1.23
Support of Extension administration.	2.93	1.27

1 = No Impact, 2=Very Little Impact, 3=Little Impact, 4=Some Impact, 5=High Impact

Research Question 6:
What are the benefits of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?

North Carolina horticulture Extension agents' perceptions of the benefits demonstration gardens bring to an Extension horticulture program were measured utilizing a web based survey. Employing a Likert scale, agents currently utilizing demonstration gardens were asked to indicate their level of agreement with ten value statements, as follows: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), or Strongly Agree (5). Value statements are listed in Table 36. Negative statements were reverse coded.

Results show that agents averaged agreeing with seven of the ten statements at the "Agree" (4.0) level or higher. The value statement found to have the highest level of agreement was "The gardens increase the effectiveness of my Extension program" (4.45), followed by "The gardens provide meaningful opportunities for volunteer service" (4.38). "Demonstration gardens are not an effective tool for teaching horticulture", a reverse coded item, was found to have the third highest average rating, at 4.31, indicating that agents perceive gardens to be an effective educational delivery method for teaching horticulture.

Averages for value statements found to have the lowest ratings fell between the Neutral (3) and Agree (4) level. The lowest rated statement was "More people attend programs because of the gardens" (3.62), followed by "The gardens attract people to my Master Gardener Volunteer program" (3.79). "Developing and maintaining demonstration gardens is an efficient use of program resources" also had an average rating below the "Agree" level, with an average rating of 3.90

Table 36

Agents' Perceptions of the Value of Demonstration Gardens, N=29

Value Statement	Mean	SD
The gardens increase the effectiveness of my Extension program.	4.45	0.57
The gardens provide meaningful opportunities for volunteer service.	4.38	0.62
* Demonstration gardens are not an effective tool for teaching horticulture.	4.31	0.85
Visitors learn when they walk through the gardens.	4.24	0.69
The gardens provide valuable opportunities for partnerships and collaborations in the community.	4.07	0.70
My classes and workshops are more effective because of the demonstration gardens.	4.07	0.75
I would recommend the development of demonstration gardens to other agents.	4.00	0.85
Developing and maintaining demonstration gardens is an efficient use of program resources.	3.90	0.82
The gardens attract people to my Master Gardener Volunteer program.	3.79	0.74
More people attend programs because of the gardens.	3.62	1.01

1 = Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree
* Reverse coded item

Research Question 7:
What competencies do NC horticulture agents require to develop, maintain, and utilize demonstration gardens as an educational delivery method for Extension horticulture programming?

The competencies required to develop, maintain, and utilize a demonstration garden as an educational delivery method for Extension horticulture programming were measured among North Carolina horticulture Extension agents who currently utilize demonstration gardens. Nine competencies were identified and are listed in Table 37. Employing a Likert scale, agents were asked to indicate their level of desire for training on each competency as follows: No Desire (1); Little Desire (2); Moderate Desire (3); High Desire (4); and Very High Desire (5).

Results show the only competency with an average rating higher than 4.0, "High Desire", was “How to evaluate the garden’s outcomes and impacts” (4.17). The top four competencies found to have average ratings above 3.0, "Moderate Desire", but below 4.0 were “How to develop and manage the garden to support self directed learning” (3.62), “How to raise and manage funds” (3.46), “How to recruit and manage garden volunteers” (3.45), and “How to utilize the garden to support non formal education efforts such as classes and workshops” (3.31).

Competencies agents were found to have the least desire for additional training were “Garden installation” (2.69), and “Garden maintenance” (2.76) which were the only training topics achieving an average rating below 3.0, "Moderate Desire".

Table 37

Agents' Desire for Additional Training, N=29

Training Topic	Mean	SD
How to evaluate the garden's outcomes and impacts.	4.17	1.07
How to develop and manage the garden to support self directed learning.	3.62	1.15
How to raise and manage funds.	3.46	1.07
How to recruit and manage garden volunteers.	3.45	0.83
How to utilize the garden to support non formal education efforts such as classes and workshops.	3.31	0.93
How to plan and design gardens for educational use.	3.24	0.95
How to develop community partnerships.	3.17	0.89
Garden maintenance.	2.76	1.02
Garden installation.	2.69	0.93

1 = No Desire, 2=Little Desire, 3=Moderate Desire, 4=High Desire, 5=Very High Desire

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This study was designed to determine the characteristics of demonstration gardens currently utilized by NC horticulture Extension agents, how they are being utilized in horticulture programs, which audiences are targeted, what features, techniques, and practices are being employed in gardens to enhance self directed learning, the challenges and benefits of choosing demonstration gardens as an educational delivery method, and the competencies required to develop, maintain, and utilize demonstration gardens as part of an Extension horticulture program. The research involved 38 horticulture Extension agents and 50 Extension demonstration gardens located in 34 counties. This chapter presents the conclusions and discussion of the research findings, recommendations, and implications for future research.

Conclusion and Discussion

Research Question 1

What are the characteristics of demonstration gardens currently utilized by North Carolina horticulture Extension agents?

<u>Conclusion 1 and Discussion</u>: Demonstration gardens are not “one size fits all” and there is no formula for the “right” Extension garden. The size, location, and plant composition of

gardens vary depending on the agent's reason for creating the garden, reflecting their program's priorities and needs.

While some commonalities were found in terms of county population, garden location, size, and plant composition, no typical Extension garden emerged among gardens identified. Extension agents based in counties across the state were found to be utilizing demonstration gardens, from counties with low populations (just over 12,000) to counties with high populations (nearly 900,000) as well as from all three of North Carolina's geographic regions (mountains, piedmont, coastal plain). While the majority of gardens were found to be located on county property (62%, with 50% located at the county Extension center), a number of gardens were located on other properties including state, nonprofit, private, and commercial, depending on the availability of land, area most likely to be visited, and location convenient for the target audience. Gardens were found to most likely have been initiated by a horticulture agent (66%), though several gardens identified were initiated by Master Gardener volunteers, other Extension staff, county government, or the host site.

Extension demonstration gardens were found to range in size from 50 sq. ft. to 33 acres. The majority of Extension demonstration gardens identified (66%) were found to be under 0.50 acres in size (21,780 sq. ft.), with many (52%) less than 5,000 sq. ft., though several larger gardens ranging from 3 to 8 acres exist. Gardens were found to most likely display ornamental plants (80%), either alone or in combination with edible plants. Edible plants were found to be represented in 66% of gardens, with 20% dedicated to demonstrating only edible plants (vegetables, culinary herbs, and fruiting trees and shrubs). The gardens containing ornamental only and mixed plantings were found to occur in a range of sizes and in counties with both high and low populations, while gardens containing edible plants only were most likely to be less than 1,000 sq. ft. and to have been developed in the last five years. Edible only gardens were found to be more concentrated in counties with lower populations (less than 45,000).

The increase in edible only gardens in the last five years is most likely due to programs adapting to address the increasing interest in home food production. Agents in Lincoln, Alexander, Pasquotank, Carteret, Catawba, and Wayne counties were all found to be utilizing small (300 sq. ft. or less) vegetable gardens, primarily in direct support of workshops and classes. The North Carolina Green Industry Council (2009) reported "grow your own" food as one of the top ten landscape trends in 2009. This shift from a focus on ornamentals to food production is being seen in public gardens as well (Dobrzynski, 2010), an example of which is the Cleveland Botanical Gardens, whose biennial flower show, the largest outdoor flower show held in the US, focused instead on locally grown fruits and vegetables in 2010.

Larger gardens (3.0 acres and over) demonstrating a variety of principles were identified as being utilized in Forsyth, New Hanover, Wilson, Dare, Transylvania, Pitt, and Guildford counties, primarily for consumer horticulture programming. All of these gardens include a mixture of ornamental and edible plantings, except Dare which just has ornamental plants. Populations in these counties range from just over 31,000 to more than 475,000, showing that larger gardens do not have to have a large county population base to sustain them.

Conclusion 2 and Discussion: The utilization of demonstration gardens by North Carolina horticulture agents is increasing.

Construction of the first North Carolina Extension demonstration garden took place in 1985 in New Hanover County. Since then the number of gardens that have been created during each five year period has increased. This has been particularly true in the last 10 years, with 33 Extension demonstration gardens (66%) constructed since 2001. Eighteen of the 50 gardens identified have been created since 2006. This increase in the use of demonstration gardens is most likely a reflection of North Carolina's growing population (North Carolina Office of State Budget Management, 2010) and the increasing interest in home gardening and do it yourself landscaping seen across the country (National Gardening Association, 2009).

Conclusion 3 and Discussion: Developing, maintaining, and utilizing demonstration gardens requires significant support.

Gardens are comprised of living, growing plants that change throughout the seasons and require regular care and maintenance. Supplies such as mulch, plants, and fertilizer, in addition to hardscape materials and equipment all contribute to the high and ongoing cost of maintaining a garden. Agents alone are rarely able to provide all that is needed to sustain the gardens they are utilizing. In fact, 34 of 35 agents currently utilizing demonstration gardens were found to receive some type of support for their garden in the form of funding, donations of goods and services, and/or volunteer service. This support was found to most likely come from Master Gardener Volunteers, garden centers and nurseries, county government, garden clubs, and landscape service companies. Thirty-three agents (94%) categorized support from at least one source as “ongoing”, indicating they have developed a partnership with this source. Renquist (2005) states that this type of long term giving to projects is the result of partnerships that are based on shared goals. The most frequently identified garden partners were Master Gardener volunteers, followed by county government, and host sites. The most frequently identified support source categorized as “occasional” was garden centers and nurseries, who most commonly donated plants, followed by garden clubs, who were more likely to donate money. Non horticultural businesses were the most frequently identified source of support categorized as “one time”, donating either money or materials.

Sources of outside funding and volunteer service were identified and found to be part of most gardens. Thirty agents (86%) identified at least one source of external funding for their demonstration garden, with Master Gardeners identified more frequently than any other source, followed by grants and county government. Thirty-four agents (97%) indicated volunteers were involved in the development, maintenance, and/or utilization of their demonstration garden, with 29 agents (85%) categorizing volunteer involvement as occurring on a “regular” basis. Without these reliable sources of funding and support it is doubtful agents would be able to utilize gardens at the extent currently seen.

<u>Conclusion 4 and Discussion</u>: Master Gardener Volunteers are key supporters of Extension demonstration gardens.

Master Gardeners have been shown to anticipate being involved in the development and maintenance of demonstration gardens as part of their volunteer experience (Mayfield & Theodori, 2006) and to value the hands on learning opportunities and community involvement this type of volunteering provides (Shrock, et. al., 2000). It is therefore not surprising that Master Gardeners emerged as the most dominant supporter of the development, maintenance, and utilization of Extension demonstration gardens. Thirty-one of 35 agents identified Master Gardeners as garden supporters. In addition, Master Gardeners were the most frequently identified source of ongoing garden support and garden funding. In support of Extension gardens, Master Gardeners were found to most likely be involved in maintenance, plant installation, and fundraising. For the 31 gardens in which Master Gardeners were involved, their volunteer roles were divided into categories of physical (design, install, and maintain gardens), fundraising, publicity and marketing, and educational utilization (lead tours, give demonstrations, develop materials for use in the gardens). This revealed Master Gardeners were involved in all four categories, and therefore fully integrated into the garden’s operation, in 65% of cases, and involved in the physical aspect of garden operation on 100% of these gardens.

Master Gardeners hold the key not only for the current but also the ongoing utilization of demonstration gardens. When asked what would be needed to realize the future goals (vision) for their garden, 67% of agents identified committed volunteers as a key requirement. More than one agent remarked that the availability and commitment of Master Gardener Volunteers to the garden's development and maintenance are the controlling factor over their use of demonstration gardens, with one agent stating "[I] will develop the gardens as the volunteer force is available" because "[I] do not want this project to get out of hand". Other agent remarks included "[I] will have no more [gardens] than there is interest and enthusiasm among the Master Gardeners to do", and "there is plenty of space but a larger core group of committed volunteers is needed to develop it".

Large numbers of Master Gardeners were not found to be necessary to develop and maintain a demonstration garden. Agents involving Master Gardeners in their garden's operation were found to have Master Gardener Programs in a range of sizes, from 11 to 260 active members. The majority of these agents (58%) had programs with 25 to 74 volunteers, divided equally between programs of 25 to 49 volunteers and 50 to 74 volunteers. Twenty-three percent of programs were found to have over 100 active Master Gardener Volunteers. Larger demonstration gardens (over three acres) were found to occur more frequently in counties with more than 100 Master Gardener Volunteers, examples of which include Forsyth, New Hanover, Dare, and Guilford.

<u>Conclusion 5 and Discussion</u>: Demonstration gardens can be part of any Extension horticulture program.

Price (1994) concluded that "demonstration gardens have enormous potential as teaching tools (p. 70)", thanks to their real life character, capacity to engage the senses, and ability to bring immediacy to a subject. As such, demonstration gardens are an ideal vehicle to teach a variety of horticultural and environmental principles and practices that are part of Extension programming. It is therefore not surprising that horticulture agents in a variety of situations were found to be utilizing demonstration gardens as part of their horticulture program. Agents were found to be based in counties with both low and high populations. Agents as well were found to be assigned a variety of responsibilities. Though gardens were found to most frequently focus on consumer horticulture issues, few of the agents utilizing demonstration gardens were found to be responsible for consumer horticulture alone. Most instead had responsibilities in consumer horticulture plus other areas, such as commercial horticulture, pesticide education, and as the county Extension director. Only one agent with responsibilities in commercial horticulture was found to currently be utilizing a demonstration garden, the Pollinator Paradise Garden in Chatham County, though several gardens were found to support green industry education, particularly training to become a Certified Plant Professional.

Research Question 2

How are horticulture agents in North Carolina utilizing demonstration gardens in their Extension education programs?

<u>Conclusion 1 and Discussion</u>: Horticulture agents are using demonstration gardens to enhance and support their educational efforts.

One-hundred percent of agents completing the web survey indicated their garden is used to enhance non formal education efforts. Agents were found to most frequently use gardens to provide hands on learning opportunities, either by directly involving audiences in the garden's maintenance, planning and development, or to provide audiences with hands on experiences during workshops and classes. This use of gardens is in agreement with Richardson (1994) who concluded Extension's "educational program delivery systems should include delivery methods that provide opportunities for clientele to gain a sensory, exploratory experience with the information being presented". These hands on, real life experiences are also a source of the concrete experiences necessary for experiential learning, as defined by Kolb's Experiential Learning Cycle (MacKeracher, 2004).

In addition to hands on experiences, agents are using gardens to support self directed learning, with 97% of agents reporting at least one feature, technique, or practice being employed in the garden to support this type of learning. Falk and Dierking (2000) point out that self directed learning in gardens, as a type of museum, is most beneficial for reaffirming knowledge necessary for long term learning. Self directed learning is more likely to occur with planned interpretation (Veverka, 2005), which can include both static and dynamic methods, such as tours and demonstrations (Osland, 2006). Seventy-seven percent of agents reported utilizing the garden to provide educational opportunities, such as garden tours and demonstrations, which would not have been possible without the gardens.

Conclusion 2 and Discussion: North Carolina horticulture agents are utilizing gardens to demonstrate multiple horticultural principles and practices.

The highest number of agents (45%) were found to demonstrate between five and eight principles and/or practices in their gardens. Seventeen percent were found to demonstrate nine or more. The most common principles and practices being demonstrated in Extension gardens, in order of frequency of occurrence, were: food production, water conservation based on plant selection and placement, plant selection based on site conditions, composting, and the use of native plants in the landscape. Gardens with a narrow focus (1 to 2 principles) were found to most commonly demonstrate food production and composting.

Conclusion 3 and Discussion: Agents are utilizing demonstration gardens to enhance their overall horticulture program.

In addition to utilizing gardens to support their educational efforts, agents are using gardens in ways that enhance their whole program. Fifty percent of agents participating in the web survey were found to conduct some type of research in their garden. Sixty-seven percent indicated the gardens facilitated the building of partnerships, while 60% use the gardens to market Extension. Volunteers were found to be involved in 97% of gardens maintained by agents participating in the phone survey, while 86% are bringing outside sources of funding into their program through the gardens. Ninety-four percent of agents indicated they have at least one partner providing ongoing support for the garden, further emphasizing the role gardens can play in engaging partners and recruiting stakeholders for Extension programs.

<u>Conclusion 4 and Discussion</u>: North Carolina Horticulture agents are not fully evaluating the impact of demonstration gardens.

Thirty-four percent of agents participating in the web survey indicated they do not evaluate the impact their garden has on their horticulture program. Sixty-six percent indicated they evaluate the garden's ability to enhance learning when incorporated into workshops, classes, and other non formal education efforts, though 100% indicated they are utilizing gardens in this way. Only 21% evaluate the garden's ability to facilitate self directed learning of garden visitors even though 97% indicated they are employing features, techniques, and practice to support this type of learning. It has been shown demonstration gardens require significant support in the form of funding, volunteer services, and donated materials, and result in the creation of partnerships with stakeholders. Fully evaluating the impacts these gardens are having would more accurately show stakeholders the value of their investment. In support of this, one agent stated "[I] could probably get more volunteers if [I] could show the value of the garden. [I] feel like this would help recruit and retain committed volunteers".

The difficulty of evaluating demonstration garden's ability to facilitate self directed learning and the impacts of that learning is one of the challenges facing agents who seek to utilize gardens in this way. Failure to capture the impact gardens are having on this type of learning sells short the value of demonstration gardens as teaching tools, as well as the impact of an agent's horticulture program. Little research has been conducted on learning that occurs in gardens, which could provide a framework for evaluation, though Hamilton and DeMarrais (2001) found that gardens can be important self learning resources for those highly intrinsically motivated to learn about gardening. Even in the field of museum learning, evaluation of self directed learning is an emerging practice, according to Lord (2007), who feels that in evaluating this type of learning “data retention is not important. What matters is whether visitors take away a new interest in or attitude toward the subject (p. 17)”. To this Falk and Dierking (2000) add museum visits should be evaluated as reinforcing experiences, valuable for their ability to reaffirm knowledge for long term learning. Through their analysis of exit surveys, Butler and Serrell (2000) show that garden visitors can acquire both short and long term knowledge from their visit, and that these experiences have the potential to impact visitors’ knowledge, attitudes, and future behaviors.

Research Question 3

Which audiences are targeted?

<u>Conclusion 1 and Discussion</u>: Demonstration gardens are being utilized to serve multiple audiences, most commonly home gardeners, Master Gardener Volunteers, and youth.

Seventy-five percent of agents participating in the web survey indicated their garden served three or more audiences. The highest number of these are serving three audiences with their garden. The most common combination of audiences identified was home gardeners, Master Gardener Volunteers, and youth. Only one agent indicated their garden served a single audience, while 20% indicated their garden is serving five or more audiences.

Research Question 4

What features, techniques, and practices are employed by agents to enhance the educational effectiveness of demonstration gardens for self directed learning?

<u>Conclusion 1 and Discussion</u>: Few Extension demonstration gardens fully support self directed learning.

Ninety-seven percent of agents participating in the web survey indicated they employ at least one feature, technique, or practice to support self directed learning of garden visitors, yet only seven percent indicated they incorporate all nine possibilities listed in the survey. Slightly more than half were found to employ five techniques or less, with one agent using none. The use of plant labels and the development of gardens around an educational theme were the most commonly employed practices. Both of these were identified by Price (1986) as important aspects of garden design in support of visitor learning. These two practices also support the "big idea" suggested by Serrell (1996) that should guide all exhibit designs.

Few agents were found to provide brochures on gardening topics or link materials in the garden to materials online, both practices that could encourage continued learning based on the garden visit experience, and identified as ways to enhance self directed learning by Falk and Dierking (2000). In addition, only a third of agents were found to provide a self guiding tour brochure for the gardens, identified by Osland (2006) as a method of engaging visitors in learning.

Gardens can support self directed learning (Butler and Serrell, 2000), (Falk & Dierking, 2000), (Hamilton & DeMarrais, 2001), (Price, 1986). This study has shown that gardens require significant inputs of time, volunteer service, funding, and support. Only by employing as many features, techniques, and practices as possible, can agents fully utilize gardens to support self directed learning, resulting in the most efficient use of resources and maximizing their horticulture programs' potential impacts. At the current time, few agents were found to be employing all of the possible techniques identified in the survey, and therefore are not fully taking advantage of the benefits facilitation of self directed learning can bring to their programs. In addition, few agents were found to be evaluating self directed learning in their gardens.

Research Question 5

What are the challenges of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?

Conclusion 1 and Discussion: Availability of time, funding, and volunteer support are the greatest challenges of choosing demonstration gardens as an educational delivery method.

Agents rated availability of time, funding, and volunteers as the greatest challenges to utilizing demonstration gardens, on a scale of one to five, with five having the highest impact. The challenge statements related to these three areas received the top five highest average ratings, all averaging ratings over 4.0 or “Some Impact”. The highest rated impact statements, in order of magnitude, were: “Time to manage the garden”; “Availability of funding”; “Time to plan and develop the garden”; “Support of Master Gardener Volunteers”; and “Availability of volunteers to work in the garden”.

These challenges are related. This study has shown that volunteers, particularly Master Gardener Volunteers, play a significant role in the development, maintenance, and utilization of Extension demonstration gardens, spending their time on these tasks, potentially freeing up agents to attend to other responsibilities. Master Gardener Volunteers are also a frequent source of funding for gardens and agents have identified committed volunteers as a key factor in realizing the future goals of their gardens. A large and committed volunteer force could provide the needed funding and labor to develop, maintain and utilize the gardens, therefore the availability of volunteer support should be considered the greatest of these challenges.

Research Question 6

What are the benefits of choosing demonstration gardens as an educational delivery method for Extension horticulture programming?

<u>Conclusion 1 and Discussion</u>: Demonstration gardens enhance the educational effectiveness of Extension horticulture programs.

In her study of home demonstration gardens for improved design and interpretation, Price (1986) concluded,

> "Demonstration gardens have enormous potential as a teaching tool. They bring an immediacy to their subject through their walk-through, real-life character and their ability to engage all of the senses. A text or mock-up exhibit, no matter how well conceived, is unlikely to convey the immediacy of a growing, changing garden. In a demonstration garden, visitors see living plants in an environment that suggests their own yard. Based on this reality, it is a small leap of faith for visitors to implement the concepts or innovate on their own property (p. 70)."

Borun (2001) as well praises the strength of the tangible, real life nature of object-based learning in museums (and by extension gardens, which are a form of museum (Falk and Dierking, 2000)), stating that in museums "concepts become tangible – a visual framework on which to hang the later acquisition of facts and more information (p.11)". This tangible, real life nature of gardens contributes to both short and long term learning and changes in attitudes (Butler and Serrell, 2000; Falk and Dierking, 2000), both of which are necessary for the behavior changes Extension education programs seek to affect.

In this study, North Carolina horticulture Extension agents utilizing demonstration gardens confirmed that demonstration gardens enhance the educational effectiveness of their programs. On a one to five scale of possible garden benefits, five being highest, agents agreed with statements related to the educational value of gardens at the 4.0, "Agree" level, or higher. These statements were: "The gardens increase the effectiveness of my Extension program.”; “Visitors learn when they walk through the gardens.”; and “My classes and workshops are more effective because of the demonstration gardens.”. In addition, the majority of respondents disagreed with the negative statement, “Demonstration gardens are not an effective tool for teaching horticulture.", affirming the effectiveness of demonstration gardens as an educational tool.

Agents were found to be utilizing gardens to enhance both non formal and informal education. The most frequent use of gardens to enhance non formal learning was in the form of learning by doing, providing learners with hands on experiences of the sensory, exploratory nature preferred by most clients participating in North Carolina Extension programs (Richardson, 1994). Learning through real experiences is at the heart of experiential learning, which begins with these types of concrete experiences (Smith, 2001). Whether agents are taking these concrete experiences through all four phases of Kolb’s Experiential Learning Cycle was not studied, but the potential to implement the cycle is certainly created when demonstration gardens are utilized.

Agents were found to be employing features, techniques, and practices in their gardens to facilitate self directed learning, the most common of which were plant labels and the development of gardens around an educational theme. Plant labels were shown by Price (1986) to be the most important feature of a garden for visitors seeking to study plants, and a major source of frustration when missing. Price (1986) also identified the development of gardens around a theme as a key design technique to enhance visitor learning. This is in agreement with Serrell's (1996) proposal of the use of an overall guiding theme, or "big idea", as an effective interpretative approach for exhibit design.

In addition, when asked how they utilize gardens in their program, 77% of agents indicated they utilize the garden to provide educational opportunities, such as guided tours and demonstrations, which would not be possible without the gardens. These forms of educational outreach are unique to physical sites such as gardens, and have been promoted as a way to creatively engage garden visitors in learning (Osland, 2006). In addition, Harmon and Jones (1997) have shown these types of field visits to increase learning and affect attitudes when combined with a traditional classroom experience. When participating in the phone survey portion of this study more than one agent commented on the ability of gardens to enhance their educational efforts, saying, "it is much easier to teach [horticulture] when you can show someone plants growing, have them plant something, and see insects and diseases first hand". The ability of gardens to affect change was also noted, with one agent commenting, "the best way to get people to change is to show them through gardens. You can't just preach at them". Agents also noted the desire by clients to engage in hands on learning, with one agent commenting that he was developing a garden because his clients "have expressed a desire to learn hands on, not just watch demonstrations or powerpoints".

<u>Conclusion 2 and Discussion</u>: Demonstration gardens effectively engage volunteers and provide meaningful opportunities for volunteer service.

When asked about her decision to develop demonstration gardens, one agent participating in this study replied, “An initial survey of my Master Gardeners when I first began indicated a great majority of them wanted to do their volunteer work in actual gardens”. This desire to work in gardens as a form of volunteer involvement is not unique. It has been shown that Master Gardeners anticipate being involved in landscape and demonstration gardening projects as a form of community involvement as part of their volunteer service (Mayfield & Theodori, 2006) and that Master Gardeners consider learning through hands on instruction and opportunities to contribute to community development as benefits of being in the Master Gardener Program (Schrock, et. al., 2000). Moravec (2006) also found a strong desire among Master Gardeners to learn through hands on activities about topics including sustainable landscaping, home gardening skills, and ornamental plants.

Demonstration gardens are providing these types of opportunities for learning and involvement, serving as an effective vehicle for the engagement and meaningful utilization of volunteers. In this study, 34 out of 35 agents indicated volunteers are involved in some aspect of their garden’s operation, with 29 agents characterizing this volunteer involvement as occurring on a “regular” basis. In addition, the statement "The gardens provide meaningful opportunities for volunteer service" received the second highest average rating on a scale of perceived benefits of utilizing gardens, topped only by the statement, “The gardens increase the effectiveness of my Extension program”.

Master Gardener Volunteers were specifically shown to be highly engaged in North Carolina Extension demonstration gardens, having initiated 10% of gardens, and identified as providing support for gardens by 89% of agents. Master Gardeners were found to be involved in the physical aspect of garden operation (design, installation, and maintenance) in 100% of the gardens in which they provide volunteer service, and to be fully engaged in all garden operation areas in 65% of these gardens.

The level of service Master Gardeners are providing Extension gardens, and the ongoing nature of this service indicate these volunteers find it to be meaningful and worthwhile. The reason for this may be related to Master Gardeners' reasons for joining the program. Several studies have found the desire to learn a major motivation of individuals joining the Master Gardener Program (Strong and Harden, 2010; Moravec, 2006; Wolford, Cox, and Culp, 2001). Helping to develop and maintain gardens can certainly provide the learning these volunteers seek.

Master Gardener's reasons for volunteering in demonstration gardens may go beyond learning. The Master Gardener Program has been shown to attract recent retirees (Rohns, Stribling, and Westerfield, 2002; Schrock, Meyer, Ascher, and Snyder 1999), many of whom are currently members of the baby boomer generation. Culp (2009) reported on the motivation of baby boomers to serve as volunteers, stating members of this generation seek volunteer opportunities "that can contribute directly to their community and have observable impacts (Boomers and Retirement, ¶ 8)". In addition, baby boomers seek opportunities that allow them to remain active, use their skills, and pursue their interests, and particularly enjoy fundraising and team efforts (Culp, 2009). The development and maintenance of demonstration gardens certainly provide these types of opportunities, and should be considered an effective way to engage volunteers of this generation in meaningful volunteer service.

Conclusion 3 and Discussion: Demonstration gardens provide opportunities for developing partnerships.

In sharing his experience of developing a demonstration garden, Renquist (2005) noted that partnerships were created with businesses and organizations, and that when based on mutual goals these often resulted in long term giving to the project. This has also been the experience of North Carolina Extension agents developing and maintaining demonstration gardens. Agents participating in the telephone survey of this study identified 15 sources of support for their gardens, of which Master Gardeners were the most common and enduring. When Master Gardeners were taken out of the support list, 24 of 31 agents continued to show as least one support source categorized as “ongoing” in nature, indicating they have developed a partnership with these sources, which included county government, garden centers and nurseries, landscape service companies, and garden clubs. In addition, the statement "The gardens provide valuable opportunities for partnerships and collaborations in the community " received an average rating of 4.07 on a one to five scale of perceived benefits of utilizing gardens, with five being highest, showing that agents do value gardens for their ability to create community partnerships.

The establishment of collaborations and partnerships and the utilization of volunteers to extend educational reach have both been identified as sources of excellence for Extension

(Archer, Warner, Miller, Clark, James, Cummings, & Adamu, 2007). The development of demonstration gardens provides opportunities to develop partnerships based on mutual goals. Agents are taking advantage of this benefit and utilizing gardens in this manner.

Research Question 7

What competencies do North Carolina horticulture Extension agents require to develop, maintain, and utilize demonstration gardens as an educational delivery method for Extension horticulture programming?

Conclusion 1 and Discussion: NC horticulture Extension agents utilizing demonstration gardens have the skills and knowledge necessary to install and maintain demonstration gardens but require additional training to evaluate their garden's impacts and to develop gardens that fully support self directed learning.

Agents participating in a web survey were asked to indicate their level of desire for training on nine subjects related to the utilization of demonstration gardens in Extension horticulture programming. The two subjects receiving the lowest average ratings were "Garden installation" and "Garden maintenance". Since these agents have already developed a garden and are currently maintaining it, it is understandable that they are comfortable with these topics and do not require further training. The two statements found to have the highest average ratings were "How to evaluate the garden's outcomes and impacts" and "How to develop and manage the garden to support self directed learning". This study has shown that many agents are deficient in these areas, with 34% indicating they do not evaluate any garden impacts and only 21% evaluating the gardens ability to support self directed learning. In addition, few gardens have been developed that fully support self directed learning. Agent's recognition of their need for training is these areas may indicate they are willing to incorporate these practices into their garden's design and utilization but lack the skills and knowledge necessary to do so.

Recommendations

Based on the findings of this study, the following recommendations are made to horticulture Extension agents who are considering developing demonstration gardens as well as those already utilizing gardens as part of their program:

1) **The development of demonstration gardens to support educational efforts and enhance the overall horticulture program is recommended, especially to agents seeking to reach home gardeners, Master Gardener Volunteers, and youth.** This study has shown that North Carolina horticulture Extension agents are currently utilizing demonstration gardens in their programs to enhance their non formal educational efforts, facilitate self directed learning, and to build partnerships. These agents are based in a variety of counties, including those with small and large populations, and with varying numbers of active Master Gardener Volunteers. In addition, the majority of agents were found to be assigned responsibilities beyond

consumer horticulture, including commercial horticulture, pesticide education, and administrative duties.

2) **There is no set formula for developing a garden.** When developing and utilizing a garden, agents should consider their program needs and what they are able to support. Gardens were found to include a variety of plants including edible only, ornamental only, and mixed plantings of both. In additions, gardens were found to occur in a wide range of sizes, from 50 sq. ft. to several acres, and in varying locations. Many gardens have been developed at Extension centers as well as a variety of other county owned, state owned, and nonprofit locations depending on availability of land and location of the target audience.

3) **When developing and maintaining gardens, Master Gardener Volunteers and other potential garden partners should be involved in the process.** Gardens require significant amounts of ongoing support in the form of funding, volunteer service, and donations of materials and services. All potential partners should be provided the opportunity to be involved in the development and the management of the gardens. Recruiting partners to serve on garden support committees or advisory groups will help invest them in the garden’s long term success.

4) **A framework for evaluating the garden’s ability to enhance learning as well as its impact on the total Extension program should be developed to capture this educational delivery method’s full value.** The garden’s ability to enhance both non formal and self directed learning, engage volunteers, and develop community partners

should be included. The ability to fully evaluate the impacts these gardens are having will allow agents to more accurately show stakeholders the value of their investment.

5) **To maximize the effectiveness of demonstration gardens as teaching tools, agents should incorporate as many techniques, features, and practices that enhance non formal education and facilitate self directed learning as possible.** Many agents were found to be incorporating gardens into non formal education efforts such as classes and workshops by providing audiences opportunities for hands on involvement with the subject matter, giving tours, and leading demonstrations. Fewer were incorporating multiple techniques to facilitate self directed learning in their gardens. Equipping gardens with the features needed to facilitate self directed learning (plant labels, interpretive signs, and brochures) increases their educational reach, allowing the garden to affect clients' knowledge of horticulture without the agent having to be present.

6) **To make the most of the resources invested in the garden, agents should integrate the garden across their whole program.** Brochures and handouts available inside the Extension office should also be available in the garden. The garden should have a presence on the county website and any other sites (blogs, Facebook, etc) maintained by the agent. In addition, online materials and resources related to the principles and practices demonstrated in the garden should be created and promoted in the garden to encourage continued learning based on the garden experience and to link the physical garden with the agent’s whole horticulture

program. Agents should use the garden to provide educational opportunities unique to gardens, such as guided tours, hands on experiences, and demonstrations. Agents should demonstrate as many principles and practices in the gardens as possible and target multiple audiences when possible. Volunteers should be engaged in the gardens creation, management and utilization.

Implications for Future Study

This study revealed the following areas that are recommended for future research:

1) Volunteers, particularly Master Gardeners, were shown to play a vital role in the operation of Extension demonstration gardens. **A study of volunteers' motivations for being involved in gardens and their perceptions of Extension demonstration gardens** would provide information agents could use to recruit, retain, and better utilize volunteers.
2) **A qualitative study of agent utilization of demonstration gardens and their feelings towards gardens as a teaching tool comparing agents in rural versus urban counties** would provide a deeper understanding of how gardens can best be implemented and utilized in counties of varying populations.
3) Few agents were found to be fully employing techniques that support self directed learning. **A study of agent’s perceptions of self directed learning in a garden setting, and of the challenges of implementing features, practices and techniques that support this type of learning** could indicate why gardens are not being fully

utilized for this purpose and provide suggestions of how to empower agents to employ these techniques.

4) In addition, few agents were found to be fully evaluating the impacts their gardens have on their horticulture program. **A study of potential impacts and their effective evaluation methods** could provide a framework for evaluation that agents could use to better capture and report the value and impacts of demonstration gardens.

5) **A study of users' perceptions of Extension demonstration gardens and their educational value** would also contribute to the development of a framework for evaluation, as well as to agents' understanding of the educational potential of these gardens.

6) Four gardens were identified as being initiated by either the whole Extension staff or another member of the Extension staff. **A study of the involvement and utilization of gardens by non horticulture agents could indicate the gardens value beyond just the horticulture program as well as the role gardens can play in integrated programming.**

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APPENDICES

APPENDIX A: Phone Survey Instrument

Agent's County:____________________

Agent Areas of responsibility:

- O Consumer horticulture
- O Commercial horticulture
- O Pesticide Coordinator
- O CED
- O Other: _______

1. Do you currently have, or have you ever had, a demonstration garden as part of your horticulture program?

   If you formerly had a demonstration garden and no longer do, why did you discontinue using it?

2. How many gardens do you utilize? Where is each garden located?

3. How do you refer to each garden? (eg. Pender County Teaching Garden)

4. What size is each garden? (sq. ft. or acres)

5. Does the garden have a web presence, such as a page on the County Extension site, blog, or facebook?

6. What types of plants are found in each garden?

   a. Ornamentals
      a. Woodies
      b. Herbaceous
   b. Edibles
      a. Vegetables
      b. Herbs
      c. Fruits
   c. Turf

7. Who (name, title/role) initiated the idea of establishing each garden?

8. What year did you break ground for each garden?

9. How is your garden supported? Have any partnerships and collaborations been involved in the creation and maintenance of this garden? Support includes donation of money, materials, services, use of equipment, and volunteer labor.

	One time support	Occasional support	Ongoing support
O County government	O	O	O
O City government	O	O	O
O Master Gardener Volunteers	O	O	O
O Public Garden specify:	O	O	O
O Local garden clubs	O	O	O
O Local civic clubs	O	O	O
O 4-H youth and volunteers	O	O	O
O Other youth clubs e.g. Boy Scouts, Eagle Scouts	O	O	O
O Non profit organizations	O	O	O
O Garden centers & nurseries	O	O	O
O Landscape service companies	O	O	O
O Community College	O	O	O
O High School – hort program	O	O	O
O Other: ____________________	O	O	O

10. Are volunteers involved in the garden's development, maintenance, and/or utilization?

    If so, what is their affiliation (Master Gardener, 4-H, etc)?

    Would you categorize their involvement as occurring on a regular or irregular basis?

11. If Master Gardener Volunteers are involved, how many active MG Volunteers do you currently have? ______________

    What role do Master Gardener volunteers play in the development, maintenance and use of the garden?

    - Design new plantings
    - Install new plantings

- o Maintain existing plantings
- o Fund raising
- o Publicity and marketing
- o Lead tours
- o Give demonstrations
- o Develop educational materials to be used in the garden
- o Other: ____
- o Other: ____

12. What groups have been organized to support the development of this garden?

    - o Advisory committee
    - o Master Gardener support teams
    - o Foundation with board of directors
    - o Other:

13. Other than yourself, are any paid staff involved in the development and maintenance of the garden?

    Paid Staff Positions:

__ full-time, permanent	__ full-time, temporary
__ part-time, permanent	__ part-time, temporary

    Source of funding:

__ county government	__ Cooperative Extension
__ city government	__ Private/grant funded
__ other:	

14. What are the sources of funding for your garden?

    - o County Budget
    - o Master Gardener Volunteers
    - o Grants
    - o Friends memberships
    - o Garden Clubs
    - o Businesses
    - o Other: ______________
    - o Other:______________

15. Estimated number of garden visitors in 2009: ____________________
    - % youth:
    - % adults:

16. What are the hours of operation of the garden (eg. 9-5, 24/7)

    Is the garden open for free or is their paid admission?

17. On average, how many hours per month do you spend working with your program's demonstration garden? Please include time spent fund raising, developing and maintaining the garden, managing volunteers, and seeking resources. Do not include time spent teaching classes, guiding tours, or developing educational materials.

    O 1 to 10 hours
    O 11 to 20 hours
    O 21 to 30 hours
    O 31 to 40 hours
    O 41 to 60 hours
    O 61 to 80 hours
    O Over 80 hours

18. What is your vision for the garden in the future?

    What would you need to make this happen?

APPENDIX B: Web Survey Instrument

Demonstration Garden Survey – page 1
This survey has three pages. As you complete each page, click submit at the bottom to continue to the next page.

Please answer the following questions regarding how you use your demonstration garden(s) to enhance your horticulture program. For each question please mark all responses that apply.

1. To enhance non formal education - Indicate which, if any, of the following techniques you use to enhance non formal education efforts.

- ☐ Audiences (Master Gardeners, 4-H youth, others) are directly involved in the planning and development of the garden(s).
- ☐ Audiences (Master Gardeners, 4-H youth, others) are directly involved in the maintenance of the garden(s).
- ☐ The garden(s) are utilized during workshops and classes to provide audiences with hands on experience of the subject matter being taught.
- ☐ Demonstrations of correct horticultural practices are led by the agent or an expert in the garden(s). Example: demonstration of how to prune.
- ☐ Guided tours are provided by the agent or a volunteer.
- ☐ No techniques are used to enhance non formal education.
- ☐ Other(s), please specify:

2. To facilitate self directed learning - Indicate, which, if any, of the following techniques you use to facilitate self directed learning of garden visitors.

- ☐ Plantings are designed to be in scale with home landscape plantings.
- ☐ Gardens are developed around an educational theme. Examples: shade garden, rain garden.
- ☐ Paths are constructed through the garden(s) to allow visitors access to the plantings.
- ☐ Seating areas are provided to give visitors a place to study and reflect.
- ☐ Plants are labeled for identification.
- ☐ Interpretive signage is placed in the garden(s) to enhance visitor understanding and learning.
- ☐ A self-guiding tour brochure is available in the garden(s).

- ☐ Brochures on gardening topics are available in the garden(s).
- ☐ Reference materials available online are promoted in the garden(s) to encourage continued learning based on the garden visit experience.
- ☐ No techniques are used to facilitate self directed learning.
- ☐ Other(s), please specify:

3. To conduct research - Indicate what types of research, if any, are conducted.

- ☐ Plant trials. Examples: new species, new varieties
- ☐ Pest control methods, organic or conventional
- ☐ Product testing. Examples: different types of fertilizers
- ☐ Production methods/horticultural techniques. Examples: straw bale gardening, pruning methods
- ☐ No research is conducted in the garden.
- ☐ Other(s), please specify:

4. Do you utilize the garden(s) in any of these additional ways to enhance your horticulture program?

- ☐ To recruit volunteers
- ☐ To train volunteers
- ☐ To build partnerships with businesses, county government, non profit groups, and others
- ☐ For fund development. Examples: plant sales, events with paid admission
- ☐ As a marketing tool to increase awareness of Extension
- ☐ To provide educational opportunities such as guided tours and hands-on workshops that you would NOT be able to provide if you did not have the gardens
- ☐ Other(s), please specify any other ways you utilize the garden:

Demonstration Garden Survey – page 2
Please answer the following questions regarding your demonstration garden(s). For each question please mark all answers that apply.

1. Which principles and practices are demonstrated in the garden(s)?

- ☐ Water wise use, xeriscaping, and/or drought tolerant plants
- ☐ Efficient irrigation methods
- ☐ Storm water management, examples: rain gardens, swales, rain water harvesting, rain barrels
- ☐ Landscaping for energy conservation
- ☐ Creating wildlife habitat, example: pollinator garden
- ☐ Food production (vegetables, fruits, and/or herbs)
- ☐ Plant selection for site conditions, examples: shade garden, bog/wet garden
- ☐ Composting
- ☐ Use of native plants in the landscape
- ☐ Use of new or under used plants in the landscape
- ☐ Plants on the certified plant professional exam
- ☐ Turf selection or turf variety demonstrations
- ☐ Landscape design principles
- ☐ Product comparisons, examples: comparison of different fertilizers, pesticide efficacy comparisons. mulch comparisons
- ☐ Technique/practice demonstrations, example: effects of different pruning methods or different pest management methods
- ☐ Other(s), please specify any others: ____________________

2. Which audiences are served by the garden(s)?

- ☐ Master Gardener Volunteers
- ☐ Home gardeners
- ☐ Green industry professionals
- ☐ Youth

- [ ] Teachers
- [ ] Other(s), please specify:

3. How do you evaluate the garden's impact on your horticulture program?

- [ ] I evaluate the garden's ability to enhance learning when incorporated into workshops, classes, tours, and/or training series.
- [ ] I evaluate the garden's ability to enhance self directed learning of individuals who visit the garden.
- [ ] I do not evaluate the garden's impact on my horticulture program.
- [ ] Other(s), please specify any other garden impacts you evaluate:

4. What methods do you use to evaluate the garden?

- [ ] Surveys
- [ ] Interviews
- [ ] I do not use any evaluation methods
- [ ] Other(s), please specify any other evaluation methods you use:

Demonstration Garden Survey – page 3
This section of the survey is designed to determine agents' perceptions of the values and challenges of using demonstration gardens as an educational delivery method in horticulture programming, and the competencies required for developing, managing, and utilizing a demonstration garden.

SCALE 1: Agents' perceptions of the value of demonstration gardens

For each of the following, please mark the response that most accurately describes your level of agreement with the statement.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The garden(s) increases the effectiveness of my Extension program.	☐	☐	☐	☐	☐
2. More people attend programs because of the garden(s).	☐	☐	☐	☐	☐

3. Visitors learn when they walk through the garden(s).	☐	☐	☐	☐	☐
4. I would recommend the development of demonstration gardens to other agents.	☐	☐	☐	☐	☐
5. My classes and workshops are more effective because of the demonstration garden(s).	☐	☐	☐	☐	☐
6. The garden(s) attract people to my Master Gardener Volunteer program.	☐	☐	☐	☐	☐
7. Demonstration gardens are not an effective tool for teaching horticulture.	☐	☐	☐	☐	☐
8. The garden(s) provide valuable opportunities for partnerships and collaboration in the community.	☐	☐	☐	☐	☐
9. The garden(s) provide meaningful opportunities for volunteer service.	☐	☐	☐	☐	☐
10. Developing and maintaining demonstration gardens is an efficient use of program resources.	☐	☐	☐	☐	☐

SCALE 2: Agents' perceptions of the challenges of demonstration gardens.

To what extent do each of the following factors impact your ability to develop, maintain, and utilize the garden(s)? For each factor, please mark the response that most accurately describes its level of impact on your garden(s).	No Impact	Very Little Impact	Little Impact	Some Impact	High Impact
11. Availability of land to develop the garden.	☐	☐	☐	☐	☐
12. Availability of funding.	☐	☐	☐	☐	☐
13. Time to plan and develop the garden.	☐	☐	☐	☐	☐
14. Time to manage the garden.	☐	☐	☐	☐	☐
15. Availability of volunteers to work in the garden.	☐	☐	☐	☐	☐
16. Community partners who will support the garden.	☐	☐	☐	☐	☐

17. Support of your County Extension Director.	☐	☐	☐	☐	☐
18. Support of county government.	☐	☐	☐	☐	☐
19. Support of Extension administration.	☐	☐	☐	☐	☐
20. Support of your Master Gardener Volunteers.	☐	☐	☐	☐	☐
21. Knowledge of techniques to evaluate the garden's outcomes and impacts.	☐	☐	☐	☐	☐
22. Time to evaluate the garden's outcomes and impacts.	☐	☐	☐	☐	☐

SCALE 3: Agents' desire for additional training.

For each of the following, please indicate your level of desire for additional training on the topic.	No desire	Little desire	Moderate desire	High desire	Very high desire
23. How to plan and design gardens for educational use.	☐	☐	☐	☐	☐
24. Garden installation.	☐	☐	☐	☐	☐
25. Garden maintenance.	☐	☐	☐	☐	☐
26. How to raise and manage funds.	☐	☐	☐	☐	☐
27. How to recruit and manage garden volunteers.	☐	☐	☐	☐	☐
28. How to develop community partnerships.	☐	☐	☐	☐	☐
29. How to utilize the garden to support non formal education efforts such as classes and workshops.	☐	☐	☐	☐	☐
30. How to develop and manage the garden to support self directed learning.	☐	☐	☐	☐	☐
31. How to evaluate the garden's outcomes and impacts.	☐	☐	☐	☐	☐

APPENDIX C: Initial Email

Dear Agents,

I am collecting information for my master's thesis. The purpose of this study is to investigate how horticulture Extension agents in North Carolina utilize demonstration gardens in their education programs. In addition, this study seeks to identify techniques and practices that agents are incorporating into demonstration gardens to enhance educational effectiveness.

If you currently have, or have ever had, a demonstration garden(s)* as part of your horticulture education program I hope you will agree to participate in this study by replying to the question below. Your participation is voluntary.

If you agree to participate in this study, please answer the following question**.

Do you currently have a demonstration garden(s)*, or have you ever had a demonstration garden*, as part of your horticulture education program?

Send your response by email to Charlotte Glen, charlotte_glen@ncsu.edu:

* = *For the purpose of this survey,* ***demonstration gardens*** *are defined as a landscape or garden planting designed and maintained under the supervision of a horticulture Extension agent for the purpose of teaching horticultural principles and practices as part of an Extension education program.*

****** = By responding to this email you are providing your informed consent to participate in this study and are verifying that you have read and agree to the conditions outlined in the attached informed consent form. This study will consist of both a telephone survey as well as a web based survey. A copy of the questions that will be asked in the telephone survey are attached.

(Attachments: Informed Consent Form, Phone Survey Questions)

Thank you,

Charlotte Glen

APPENDIX D: Web Survey Email

Dear Agents,

Thank you for participating in the phone survey portion of the study of how NC Extension agents are utilizing demonstration gardens in their educational programs. Here is the URL for the web survey portion of the study.

http://ceres.cals.ncsu.edu/surveybuilder/Form.cfm?testID=10465

The survey should take approximately 15-20 minutes to complete. The survey has 3 pages - please be sure to hit 'submit' at the bottom of each page. Your participation is needed by Friday, Sept. 17, 5pm, and is greatly appreciated!

Web Survey Details
While the phone survey focused on the characteristics of your demonstration garden, the second part of this study will ask you how you are utilizing the garden in your programming efforts, as well as your perceptions of the values and challenges of utilizing demonstration gardens and the competencies required to do so. Data for the second part of the study will be collected through a web based survey, available at the URL listed above.*

Your time and input are valuable! Findings from this study will be used to market Extension's programs, seek funding for resources needed to enhance demonstration garden development, develop training in identified areas, and will benefit agents who currently have or are considering developing a demonstration garden by enhancing our understanding of the role demonstration gardens can play within Extension's programs.

Please complete this survey at your earliest convenience before Sept. 17th. This survey should take less than 30 minutes to complete. Your participation is greatly appreciated. Completion of this survey concludes your participation in this study. Thank you for your time.

* *By completing this online survey you are providing your informed consent to participate in this study and are verifying that you have read and agree to the conditions outlined in the attached informed consent form. This is the same consent form sent with the initial email request for participation.*

(Attachment: Informed Consent Form)

APPENDIX E: Demonstration Garden Characteristics

County	County Population	Garden Name	Garden Location	Year Est.	Plant Composition	Current Size Square Feet	Current Size Acres
Alamance	148338	Arbor Gate Teaching Gardens	Extension Center	2003	mix	20000.00	0.459
Alexander	37316	Taylorsville Learning Center Community Garden	Extension Center	2007	edible	120.00	0.003
Brunswick	107127	Brunswick Botanical Gardens	Extension Center	1994	ornamental	87120.00	2.000
Buncombe	230421	Compost Demonstration	Western NC Farmer's Market	1995	ornamental	200.00	0.005
Buncombe	230421	Heirloom Garden at WNC Nature Center	WNC Nature Center	1995	mix	800.00	0.018
Buncombe	230421	Manna Food Bank Vegetable Garden	Manna Food Bank	1998	edible	1200.00	0.028
Buncombe	230421	Plant Professional Landscape Garden	NC Arboretum, Asheville	2000	ornamental	108900.00	2.500
Carteret	64712	Vegetable Garden at Carteret Community College	Carteret Comm. College	2002	edible	250.00	0.006
Carteret	64712	Butterfly Pathway at Core Sound Museum	Core Sound Museum and Heritage Center	2002	ornamental	350.00	0.008
Carteret	64712	Leffer's Garden at Beaufort Historic Site	Beaufort Historic Site	2005	mix	500.00	0.011
Carteret	64712	Rain Garden at Pine Knoll Shores Aquarium	NC Aquarium, Pine Knoll Shores	2005	ornamental	3600.00	0.083
Catawba	157002	Raised Bed Garden	Extension Center	2010	edible	300.00	0.007

APPENDIX E Continued

County	County Population	Garden Name	Garden Location	Year Est.	Plant Composition	Current Size Square Feet	Acres
Chatham	62482	Pollinator Paradise Demonstration Garden	Chatham Marketplace	2008	ornamental	14374.80	0.330
Cherokee	27090	Community Garden	County Property	2009	edible	21780.00	0.500
Craven	100261	Demonstration Garden	Extension Center	1989	mix	10890.00	0.250
Cumberland	321071	Master Gardener Demonstration Garden	Extension Center	2009	mix	21780.00	0.500
Dare	34355	Outer Banks Arboretum and Teaching Garden	Senior Center, Kill Devil Hills	2001	ornamental	130680.00	3.000
Davidson	159947	Demonstration Gardens	Extension Center	2003	mix	21780.00	0.500
Durham	266132	MG Demonstration Garden	Extension Center	2003	mix	1500.00	0.034
Forsyth	355575	Demonstration Garden	Extension Center	1998	mix	65340.00	1.500
Forsyth	355575	The Arboretum at Tanglewood	Tanglewood County Park	2000	mix	348480.00	8.000
Gaston	207234	The Learning Garden	Extension Center	1990	ornamental	1200.00	0.028
Guilford	475953	Legacy Demonstration Garden	Extension Center	1990	mix	130680.00	3.000
Johnston	168217	Demonstration Garden	Extension Center	2005	mix	3500.00	0.080
Lenoir	57221	Kinston/Lenoir County Children's Garden	County Park	2006	mix	28749.60	0.660
Lincoln	75702	Raised Bed Garden	Farmers Market	2010	edible	50.00	0.001
Moore	86945	Senior Center Garden	Senior Center	2006	ornamental	500.00	0.011
Moore	86945	Weymouth Center Gardens	Weymouth Center	2008	ornamental	1000.00	0.023
Moore	86945	Xeriscape Demonstration Garden	Extension Center	1996	mix	3000.00	0.069

APPENDIX E Continued

County	County Population	Garden Name	Garden Location	Year Est.	Plant Composition	Current Size Square Feet	Acres
Moore	86945	Historic Courthouse Garden	County courthouse	2008	ornamental	43560.00	1.000
Nash	95804	Nash County Arboretum	Extension Center	2001	ornamental	87120.00	2.000
New Hanover	194054	New Hanover County Arboretum	Extension Center	1985	mix	304920.00	7.000
Pamlico	12838	Vegetable Garden	Extension Center	2009	edible	5000.00	0.115
Pasquotank	41845	Raised Bed Garden	Extension Center	2008	edible	250.00	0.006
Pasquotank	41845	4-H Garden	Local Farm	2010	edible	1000.00	0.023
Pasquotank	41845	Hide-N-Woods Gardens	Private Property	2003	mix	60984.00	1.400
Pitt	158541	Pitt County Arboretum	Extension Center	1998	mix	130680.00	3.000
Polk	19355	Master Gardener Demonstration Garden	Extension Center	2004	mix	1500.00	0.034
Polk	19355	Arboretum	Polk County High School	1993	ornamental	1437480.00	33.000
Randolph	142467	Demonstration Garden	Extension Center	2008	mix	43560.00	1.000
Sampson	65406	Demonstration Garden	Extension Center	2009	mix	3000.00	0.069
Stokes	46792	Stokes County Extension Garden	Extension Center	2005	mix	7300.00	0.168
Transylvania	31091	Gardens at Silver Mont	Silver Mont Park	2000	mix	130680.00	3.000
Union	196322	The Teaching Garden	Extension Center	2007	mix	65340.00	1.500
Wake	892409	Lake Crabtree Water Wise Garden	County Park	2003	ornamental	3000.00	0.069
Wake	892409	Water Wise Garden	NC Fair Grounds	2005	ornamental	4500.00	0.103
Wayne	116554	Library Vegetable Garden	Public library	2009	edible	300.00	0.007

APPENDIX E Continued

County	County Population	Garden Name	Garden Location	Year Est.	Plant Composition	Current Size Square Feet	Acres
Wayne	116554	Stony Creek Butterfly Garden	County Park	2010	ornamental	500.00	0.011
Wayne	116554	MG Demonstration Garden	Extension Office	1995	ornamental	1000.00	0.023
Wilson	80005	Wilson Botanical Gardens	Extension Center	1995	mix	261360.00	6.000