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Planting More than Just Veggies: Student-Created Plans for a Sustainable Urban Farm

Daniela Shebitz
Kean University
dshebitz@kean.edu

Sergio Capozzi
Groundwork Elizabeth

Jackie Park Albaum
Groundwork Elizabeth

Abstract: We present a non-formal learning experience between Kean University students and Groundwork Elizabeth that draws upon the ecologically renewing and civically engaging mission of renewable agriculture. Under increasing urbanization pressure in the New York Metropolitan Area, Groundwork Elizabeth emerged as a nonprofit organization dedicated to address challenges of food security and environmental degradation. During the spring of 2015, 17 students in the School of Environmental and Sustainability Sciences at Kean University created a plan for the design and management of the Liberty Hall Farm, which Groundwork Elizabeth manages. The capstone students worked on six projects that were proposed by the Groundwork Elizabeth: 1) permaculture design, 2) water management, 3) soil management, 4) a medicinal plant garden design and implementation, 5) an online farm records tracking system, and 6) education curricula for primary and secondary schools visiting the farm. A summary of these actions and the project outcomes are presented.

Keywords: Senior capstone, sustainable agriculture, permaculture, urban farming

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Dr. Daniela Shebitz is an Associate Professor and Program Coordinator of Environmental Biology and Sustainability Science at Kean University. She is a restoration ecologist and ethnobotanist focusing on the sustainability of culturally important species and ecosystems through active management. Daniela serves on the board of many sustainability-based organizations such as New Jersey Higher Education Partnership for Sustainability (NJHEPS), the Hanson Park Conservancy, and the Society of Ethnobiology.

Sergio Capozzi is the Director of Red Canoe, an environmental consulting firm that supports public and private organizations on their land and resource management, stewardship of public landscapes, and sustainability efforts. He is a social scientist with a passion and broad experience in facilitating rewarding interactions and connections between people and their environment. He currently is the Farm Manager, overseeing the planning and daily operations at the Liberty Hall Farm.

Jackie Park Albaum is the Farm & Garden Director of Groundwork Elizabeth. She oversees the day-to-day operations of the Come Grow With Us! Community Farm and Garden initiatives including Liberty Hall Farm, the community Partner Gardens, AgLabs, Farm & Garden Adventures, FoodShare, UCMG Community garden grants program in 2016 and the More P.E.A.S. initiative. Jackie has an extensive background in communications, design, resource development, non-profit management, urban agriculture and sustainability. Email: Jackie@groundworkelizabeth.org

Introduction

Although urban areas occupy only 2-3% of Earth's surface, it is projected that 75% of the world population will inhabit them by the year 2030 (Triantakonstantis and Mountrakis 2012). As the world population approaches 7.5 billion people, there is a widespread decrease in small-scale farming in urban centers and a growing divide between human habitat and the land that produces their food (Angotti 2015). Regenerative agriculture, however, calls for locally adapted farms that minimize inputs and chain distances. This movement involves a wide-scale transition from open or leaky farming systems to semiclosed or regenerative systems through agronomic–urban mosaics that include smaller-unit farming (Pearson 2007). Indeed, in many metropolitan areas throughout North America, there is a growing interest in urban agriculture by virtue of its many benefits to the local communities, ecosystems, and economy. For example, urban agriculture improves access to healthy food, promotes social cohesion, improves economic wellbeing, creates opportunities for physical activity and revitalizes low-income communities (Angotti 2015).

Union County, New Jersey is part of the New York Metropolitan Area and one of the most densely populated counties, in the most densely populated state of the United States (usa.com). Under increasing urbanization pressure, Groundwork Elizabeth emerged as a nonprofit organization dedicated to address challenges of food security and environmental degradation in Union County. One of the recent initiatives that they have undertaken is the management of a five acre farm located on Liberty Hall of Kean University. As the ancestral home of the first governor of New Jersey, William Livingston, Liberty Hall has been a quiet bystander to over 200 years of American history. Initially cultivated to deliver food for the residence of Governor Livingston, Liberty Hall Farm now supplies fresh produce to an on campus farm-to-table restaurant, local nonprofit community groups and food pantries. Within the first year of their management (2014-2015), Groundwork Elizabeth worked with volunteers from Kean University and other community groups to grow over 90 varieties of fruits, vegetables, herbs and grains without synthetic herbicides, pesticides, or fertilizers. While the goal of the farm is to sustainably grow food for local consumption, the overall influence that it is having goes much deeper than the fresh produce that it delivers. The Liberty Hall Farm is quickly becoming an essential part of the learning experience for the college students of Kean University. Over the past year, Kean students have logged over 500 hours volunteering on the farm as individuals, with clubs, with classes, or as interns (Figure 1). Their contributions extend beyond the acts of planting and harvesting.

Figure 1. Local high school students volunteering to plant tomatoes on the Liberty Hall Farm.

The area of sustainability education has seen an increase in energy and vitality in a time when distance learning, video conferencing, and the "extreme individualization and portability of learning" has characterized much of higher education (Roberts 2013). The Independent Practicum for Sustainability (SUST 4300) at Kean University is the senior capstone for students majoring in Sustainability Science and Environmental Biology. It is designed to serve as a transition from undergraduate student education to post-graduate work that builds skills in leadership and management while reinforcing knowledge gained through previous coursework. Therefore, it follows the environmental capstone model of senior team projects for clients in order to address problems with social, economic and environmental dimensions (Shay 2013). Student-centered learning opportunities, including experiential learning, facilitate students acquiring knowledge through problem-solving and critical thinking (Huba & Freed, 2000;

Driscoll 2011). Sustainability-based experiential learning projects, in particular, have a strong impact on both the sustainability measures as well as on the problem-based collaboration between students, faculty and staff (Roberts 2013).

Through this paper, we present a non-formal learning experience that draws upon the ecologically renewing and civically engaging mission of renewable agriculture (Pearson 2007). By their very nature, the fields of sustainability and agricultural education, including farm planning and business management, provide ideal subjects for non-formal learning (Driscoll 2011). In the spring of 2015, SUST 4300 was taught in the student-centered, experiential learning framework of an agricultural/environmental consulting firm, where the students adopt a client who suggests a project that students assist in designing, managing, or implementing. Through this technique, the capstone is both challenging and satisfying since the students are responsible for conceptualizing the end-products, formulating strategies, communicating effectively with clients, and managing the project (Shay 2013). While most of the semester was dedicated towards this large project, the class met regularly for lessons on job and graduate school preparation including searching for opportunities, resume and cover letter writing, and mock interviews.

The Overall Structure of the Capstone Project

Through the spring of 2015, 17 students in the School of Environmental and Sustainability Sciences at Kean University created a six-part plan for farm design and management, with Groundwork Elizabeth serving as their client. This structure contributed to their professional development so that they learned to navigate team dynamics while catering to a client's requests. During the first meeting of the semester, the students learned about the consulting process and were asked to research Groundwork Elizabeth. The client (represented by the lead farmer, Jackie Park Albaum) met with the class and presented her request for six proposed projects that she had written up formally in an RFP (request for proposals): 1) permaculture design, 2) water management, 3) soil management, 4) a medicinal plant garden design and implementation, 5) an online farm records tracking system, and 6) education curricula for primary and secondary schools visiting the farm.

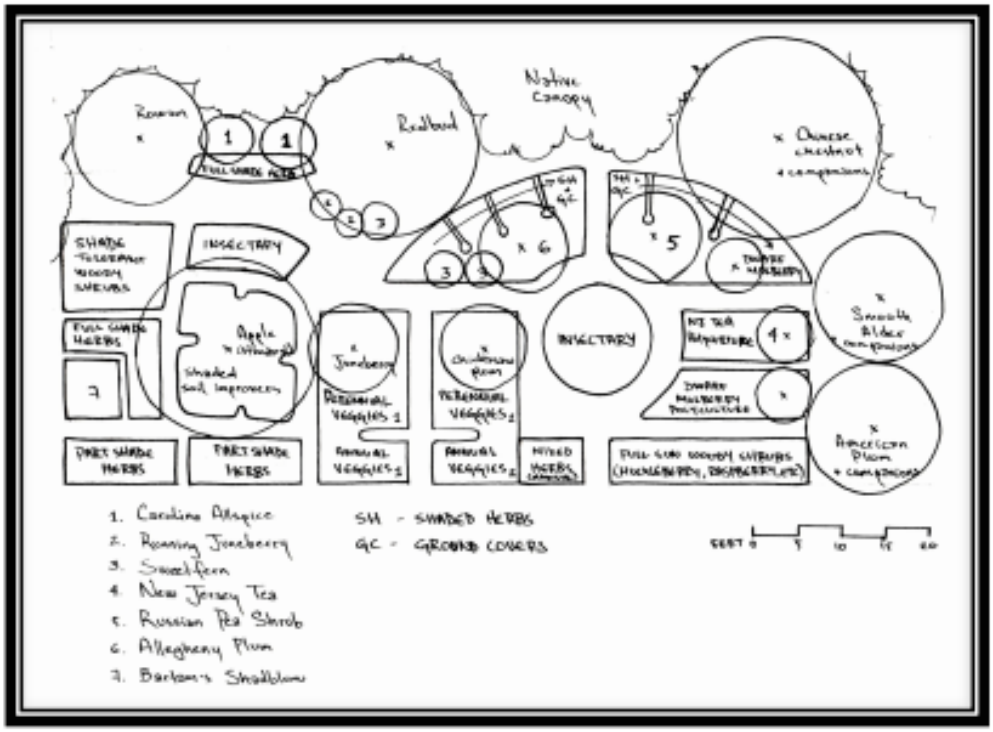
The students first divided into the six "teams" based on their strengths and interests, with one student designated as the PM, one as the Assistant PM, and one as the Technical Editor (who was also on a "team"). After the initial proposal was prepared by each of the teams and compiled by the PM and APM, the teams met individually with the client and faculty to discuss their particular goals and objectives for the semester. Some were asked to modify their proposal based on discussions that ensued. The class worked throughout the remainder of the 15-week semester on their project, checking in biweekly with their PM and APM as well as with the sponsoring professor (Dr. Daniela Shebitz). In the final weeks, they compiled a final document that was edited by the student serving as a technical editor. A week before the end of the semester, an oral presentation was given to the client that was also open to the faculty, staff and administration of the College of Natural, Applied and Health Sciences of Kean University. The client and faculty had the following week to review and return the final project to the students who had to make the changes that were suggested.

Permaculture

The permaculture plan sought to expand the diversity of produce available at Liberty Hall Farm by including forest trees, while introducing exemplary models of sustainable farming and food production practices. The permaculture team was responsible for creating a design of a food forest for Liberty Hall Farms on a plot of land measuring 100ft x 50ft that connected with the existing forest. The client requested that the food forest also include an insectary and Hugelkultur beds that would be representative of a 'rediscovery' of pre-industrial farming practices that sustained large populations. These older food production traditions, combined with more modern knowledge and innovations regarding agriculture and ecology have contributed to successful adaptations of these non-conventional farming methods.

The goal of the permaculture plan was to create a self-sustaining ecosystem that mimics the way plants would interact in a woodland setting, while still providing valuable food production services. It was developed following design principles that emphasize the importance of ecological interactions that inherently define areas of high biodiversity including nitrogen fixation and nutrient cycling and sequestration. These methods are developed to minimize waste and maximize efficiency of the resources used and produced. Even the Hugelkultur beds themselves were designed to limit waste. Hugelkultur is the process of making raised beds made with biodegradable materials, which mimic natural microtopography (The Permaculture Research Group, permaculturenews.org). These beds are made with compostable materials that act in a process of natural decomposition, which then supply nutrients back into the soil.

The students included in their final deliverable a plant list of species suggested for installation in the food forest organized by Latin and common names, with columns for the sunlight, moisture, pH, and ecological functions as well as a planting design (Figure 2). They also developed a five year planting and maintenance plan.



Long-Term Water Distribution Plan for Liberty Hall Farm

The water management student team assessed the necessity of a long-term water distribution plan in Liberty Hall Farm. Their main goal was to develop a sustainable irrigation plan that will resourcefully irrigate crops. By focusing on the importance of water conservation in an urban farm, including the history of the location, total water usage in farm, and a proper determination of which irrigation system to use, they aimed for Liberty Hall Farm to serve as a sustainable model for other urban farms.

A site assessment was conducted that included measuring the dimensions of each area and identifying the available water sources in order to select a suitable irrigation system. There was a clear need to provide an efficient watering system that delivers water to crops with consideration to total water usage. After researching the hydrological history of the site, they were able to determine the potential strategies for irrigating the area sustainably and efficiently. They determined that a drip irrigation system that targets root zones directly, increasing the efficiency of irrigation is the most effective irrigation method for conserving water on the site. They also considered the type of crops that would be planted, the filtration that the irrigation system provides and the overall cost of project. A map of drip lines and a water schedule plan was also developed to meet the needs of the farm. Rain garden installations and rain barrels to capture rainwater for the demonstration garden were also suggested.

Soil Management & Conservation

The soil management student team had the goal of developing a long-term soil conversation plan for Liberty Hall Farm that would enhance the soil fertility to provide higher crop yields for the farm without compromising the integrity of the land or community now and into the future. A key goal for the students was to develop an understanding of the physical, biological and chemical aspects of the existing soil and the complex food web that exists in the soil ecosystem that helps to cycle nutrients essential to soil and plant health (University of Vermont 2014).

The students collected soil samples that were sent out for analysis and conducted hands-on soil tests in Kean laboratories to evaluate the soil health of the farm. After this assessment was completed, the students identified organic fertilizers and fertigation delivery system (fertilizer delivered via the drip irrigation system) ideally suited for the unique conditions of Liberty Hall Farm. Part of the soil team's task was to integrate the approximately 20,000 pounds of compost produced annually from the aerobic in-vessel food and organics composter that is housed at Kean University. The composter converts all of the campus cafeteria's food waste into compost and is the center of the Food Scraps Laboratory. The students delivered a detailed plan to mix the still hot compost into existing green waste and dried leaves collected on campus.

The long term soil conservation plan delivered included a cover crop rotation system that would both protect and enrich the soil as well as a 3 to 5-year plan to convert one acre of the farm into a no-till field in order to decrease soil erosion, increase the soil's biological fertility, and increase organic matter and water retention. An informative section on Korean Natural Farming with IMO's (indigenous microorganisms) was included in the plan as a suggestion for the future.

Additionally, the soil management team provided community educational outreach programs such as soil lesson plans for farm camps and an informative brochure on soil for a farm.

Medicinal Plant Garden

A medicinal plant garden was designed by the capstone class to provide a platform for students, educators and the urban community to explore plants used as medicine historically and today. The students were charged with developing a design for a garden in a 50 x 50 ft. area with plants that would have been used by the residents of New Jersey when Liberty Hall was built, in the 1700s. The design process consisted of the following five steps: site analysis, garden layout design, medicinal plant and seed selection, construction of raised beds, and garden maintenance plan. They also began growing some of the plants for the garden by seed in the campus greenhouse. The garden featured eight, 2 x 10 ft. raised beds. The beds are arranged according to the therapeutic use of the plants into the following themes: First Aid, Skincare, Cold and Flu, and Culinary Medicine. The students worked with the farmers and volunteers to install the gardens at the end of the semester (Figure 3). In addition to the garden design, educational tools such as lesson plans and brochures were created for a K – 12 summer camp program hosting over 100 children from urban school districts.

Figure 3. The Kean University SUST 4300 students and faculty constructing the medicinal plant garden at Liberty Hall Farm.

Farm Tracking System

The goal of this student team was to create a farm tracking system used to input crop data and record service hours of employees and volunteers. The students researched three possible solutions for our client: Appnitro, Homestead, and Google Forms. They determined that Google Forms seemed most appropriate for the needs of the client with the added bonus of being free. Google Forms enables users to create a form such as a questionnaire or a survey and link it to a spreadsheet in Google Sheets, which can then be downloaded as a Microsoft Excel spreadsheet. In addition to organizing data in easy-to-read and user-friendly spreadsheets, it also provides very visual data analysis summaries in the form of pie graphs, charts, and pivot tables. The Google Form created by the farm-tracking team asked staff and volunteers to log their time worked on the farm, and to include the name of the crops that they planted or harvested, the weight of the yield, and to note if there was any damage to the crops.

Agricultural Education

As part of the educational mission for both Groundwork Elizabeth and Kean University, some of the SUST 4300 students were charged with developing curricula for K-12 students who visited the farm. There are two different types of learning opportunities that were considered: field trips and summer camps. This team consisted mostly of students who were going to be pursuing a career in teaching. They developed field trip options for students of all grade levels (Table 1). All

of these curricula were incorporated in the lesson plans for the farm and were implemented in the summer following the capstone.

Grade	**Time**	**Liberty Hall medicinal garden**
Grades 7-8	2-3 hrs	Participants will learn about plant and natural health remedies, and will be able to prepare and take home a healing salve they make.
Grade	**Time**	**Soil erosion**
All grade levels	1 week	Participants will discover relationships between precipitation, soil erosion, protection of watershed, and vegetation.
Grade	**Time**	**What's in our dirt?**
Grades 1-4	1 hr	Participants will learn to extract and identify different decomposers that provide nutrients to our soil for plant growth and understand their ecological role.
Grade	**Time**	**Make your own earthworm farm!**
Grades 5-6	3 hrs	Participants will see the importance of soil vitality and plant value to our soil. The class will help construct and maintain an earthworm farm.
Grade	**Time**	**Nature's filter**
Grade 3	1 hr	Participants will discover healthy soil will act as a physical and chemical filter of impurities within the soil.
Grade	**Time**	**How to plant a seed**
Pre-K-Grade 5	1 hr	Participants will learn about the life cycle of plants, and how to identify species and their life history strategies based on the seeds' physical appearance
Grade	**Time**	**Green on the farm**
Grades 6-8	1 week camp	Participants will learn a variety of sustainable farming methods including water conservation, soil nutrition, chemical alternatives and product distribution.
Grade	**Time**	**Nutrition and gardening**
Grades 6-12	Weeks	Participants will understand the steps taken to grow produce and learn about a healthy diet through harvesting and cooking/preparing meals.
Grade	**Time**	**Weeding out the pesky plants**

Grades 3-5	1 day	Participants will learn how to identify and control weeds on a farm sustainably, and even learn of medicinal or edible uses for some of the species.
Grade	**Time**	**From garbage pits to dinner hits**
Grades 7-12	Two hours	Participants will be introduced to the benefits and methods of composting and understand how it is a perfect example of recycling.
Grade	**Time**	**Let's purify**
Grades 6-8	1 hr	Participants will understand how water filters work, and will construct a functional filter of their own. They will understand the different types of water at Liberty Hall Farm.
Grade	**Time**	**How to design a food forest**
Grades 9-12	1-3hrs	Participants will understand the benefits and identify the structure and components of a food forest. They will be able to design a sample food forest of their own.
Grade	**Time**	**The three sisters**
Grades 6-12	1-3hrs	Participants will understand the differences between monoculture and polyculture, as well as the benefits to the 3 sister crops (corn, beans and squash) that were planted together by many Native Americans. They will be able to observe how each crop helps the others to grow on the farm. Older students can quantify yields from the plants grown as monoculture versus those grown in polyculture.

Project Outcomes

Student Feedback

At the end of the spring semester, the students were asked to provide feedback on their experience in the capstone. The feedback provides insight into the students' experiences, as well as several outcomes that may influence future capstones at Kean University and beyond. In particular, while many of the students gained exposure to farming, they also gained transferable communication and organization skills that are applicable to other future careers pertaining to sustainability.

Specific to the capstone project, the students were asked in the survey to indicate which elements of the project were the most successful. The students considered the educational and permaculture plans to be the most successful components of the project, while the farm records tracking system was the least successful. They judged elements of the project to be successful if they were well researched (e.g., "involved more research"), provided ample technical detail (e.g., "provided clear plans for implementation"), were forward thinking and creative (e.g., "beneficial…especially in future years," "creative and unique"), and best met the client's needs (e.g., "designed to the client's wants/needs").

While the students appreciated the opportunity to better understand farming, and specifically the agricultural systems being explored and implemented at the Liberty Hall Farm, they also valued

the general learning opportunities and experiences that were fundamental to the capstone. For many of the students (more than 75%), conducting field work and working with a subgroup of their peers were "very effective" elements of the capstone. Additionally, the students appreciated the opportunity to have both a project manager and a technical editor, roles not typically incorporated into academic group work, as elements of the capstone (more than 65% of students identified these elements as "very effective" components).

Overall, more than 90% of the students indicated that their experiential learning experience in the capstone was "very effective" in teaching them about sustainability and environmental principles that they could apply in real-life situations, which the remainder said that it was "somewhat effective". In particular, the majority of participating students (more than 90%) indicated that the capstone "greatly" influenced their ability to design a field study, work as part of a team, and report their findings both orally and in a written document. This is level of influence is echoed in many of the open-ended responses students provided, including:

> *"I was able to learn how to work as a team and be able to manage not only writing a paper, but being able to communicate with an actual client. It was important to be out there and doing research, working on project and presenting the final outcome."*

Since the capstone was administered to give students an opportunity to learn about, explore, and experience the roles and responsibilities of an environmental consultant, much of their feedback focused on the specific skills they honed and could apply to their eventual careers. All of the students felt that the capstone either "somewhat" (64%) or "greatly" (36%) influenced their career objectives. Students appreciated both the opportunities and challenges that came from participating in all phases of the capstone, from proposal development through to the final project and presentation. As one student noted,

> *"It influenced my professional skill set by teaching me how it is necessary to be organized, well researched, and able to communicate effectively, when working on any type of project."*

The students repeatedly commented on the effectiveness of the capstone as both a topicdriven learning experience, as well as a career-based skill development opportunity (as exemplified by the quotes from students below).

"It taught me how to critically think, as well as work on a team to come up with the best possible solutions."

"It was definitely a great learning experience and it was one of the courses that will inevitably help me in my future career."

The dual purpose and overall success of the Liberty Hall Farm project provides a model for future capstone courses. These types of learning experiences not only broaden a student's

educational experience, but also provide students with skills that may prove valuable to future employers.

Additional Project Outcomes

At the end of the spring semester, the students delivered an 80-page document that exceeded the client's expectations. In fact, Groundwork Elizabeth presented the permaculture plan as part of a large grant proposal to the New Jersey Department of Environmental Protection and was awarded a $250,000 grant to fund the More P.E.A.S. (Permaculture Education in Agricultural Systems) initiative. The More P.E.A.S. initiative promotes three key tenets of permaculture: environmental stewardship, social and cultural revitalization, reinvestment and recycling. Together, these efforts aim to improve access to healthy foods, strategies to build sustainable agricultural systems, development of green-focused career opportunities, and quality of life in socially and economically-challenged areas of the City of Elizabeth, Union Township, and other urban sections of Union County.

Another great outcome of this project is that the students are now seeing personal benefits through their work on the practicum. For example, the students who developed the water management plan were awarded a Student Research Project in Sustainability Award through the New Jersey Higher Education Partnership for Sustainability (NJHEPS) soon after the project's completion. Amazingly, one of those students was offered a job in water management upon her graduation, in large part because of her work on the Liberty Hall Farm. The PM of this project was recently hired by a large energy firm as a manager and during the interview the committee told him that they were very impressed by his management experience in the capstone. He was able to specifically answer questions pertaining to team management, motivating his peers to excel, and balancing multiple tasks simultaneously based on his experiences with this project.

It is clear that this is the start of a strong partnership that will benefit those students directly involved, but importantly is helping the larger community and environment as well. Through this collaboration, the students of Kean University and other volunteers are working with Groundwork Elizabeth to establish strong roots that spread from the Liberty Hall Farm throughout Union County. The student-centered, experiential learning framework of this project is easily transferable to other areas around the world, and serves as an important model for integrating education and regenerative agriculture.

References

Angotti, T. 2015. Urban agriculture: long-term strategy or impossible dream? Lessons from Prospect Farm in Brooklyn, New York. Public Health 129(2015): 336- 341.

Driscoll, B.A. 2011. Graduates' perspectives regarding the impact of the integration of experiential learning in academic programs. Graduate Theses and Dissertations. Paper 12116.

Huba, M.E. and J.E. Freed, 2000. Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning. Pearson.

The Permaculture Research Institute. http://permaculturenews.org/. Accessed January 25, 2017.

Pearson, C.J. 2007. Regenerative, Semiclosed Systems: A Priority for Twenty-First-Century Agriculture. BioScience, 57(5):409-418.

Roberts, J. 2013. Experiencing Sustainability: Thinking deeper about experiential education in higher education. The Journal of Sustainability Education Vol. 5, May 2013 ISSN: 2151-7452

Shay, E. 2013. Sustainability capstones: Data-driven, policy-relevant projects to enhance learning". The Journal of Sustainability Education Vol. 5, May, 2013: ISSN: 2151-7452.

Triantakonstantis, D. and G. Mountrakis. 2012. Urban Growth Prediction: A Review of Computational Models and Human Perceptions Journal of Geographic Information System, 2014, 555-587 http://dx.doi.org/10.4236/jgis.2012.46060

University of Vermont. 2014. Vermont Crops and Soil. Session II. Understanding Soil Nutrients. http://pss.uvm.edu/vtcrops/DiggingIn/Digging_In_II_Understanding_Soil_Nutrients.pdf Accessed January 25, 2017

USA.com http://www.usa.com/rank/new-jersey-state--population-density--county-rank.htm. Accessed January 25, 2017.