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School Gardens: Cultivating a Child's Nutritional Habits, Environmental Knowledge, and Sustainability Practices

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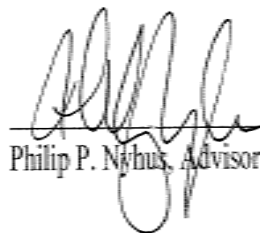
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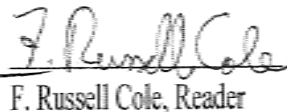
School Gardens: Cultivating a Child's Nutritional Habits,
Environmental Knowledge, and Sustainability Practices

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May 18, 2015

A thesis submitted to the faculty of the Environmental Studies Program in partial fulfillment of the graduation requirements for the Degree of Bachelor of Arts with honors in Environmental Studies.



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ABSTRACT

School gardens have existed since the late nineteenth century and today are becoming increasingly popular in many parts of the world, including where I studied in Maine and Australia (AUS). Multiple organizations support school gardens in Maine, including the Maine School Garden Network, which has over 125 registered school gardens. In AUS, the Stephanie Alexander Kitchen Garden Foundation primarily supports the school garden movement and has over 800 registered school gardens. While many researchers have studied school gardens, few have compared two countries, focused on environmental sustainability, or investigated Maine in particular. This thesis combines information from literature reviews, and primary research carried out in Maine and AUS using surveys, participant observation, and interviews to answer three specific study questions: (1) How do school gardens impact student nutritional habits, knowledge of the environment, and practices of sustainability in Maine and AUS? (2) What organizations exist in Maine to support school gardens and what are their roles? and (3) What factors contribute to successful school garden programs?

After reviewing the literature; observing 6 schools; interviewing 14 teachers and experts; and surveying 11 parents and 40 students, I found that school gardens hold the potential to: encourage students to eat more nutritious diets, teach students about environmental processes and issues, and inspire students to live environmentally friendly lifestyles. I also developed a set of 11 factors that contribute to successful school gardens by which I ranked my six study sites: clearly defined goals; passionate teachers; paid coordinators; stakeholder groups; using the garden regularly to teach nutrition, environmental science, and sustainability; parent and community involvement; greenhouses and winter programs; selling garden items for funding; small group sizes; student leadership; and planned maintenance over breaks. Because of their promising potential, I recommend that, through the Child Nutrition Act Reauthorization, policymakers in the United States appoint state-level farm to school staff members and increase grant funding to adequately support school garden programs.

ACKNOWLEDGEMENTS

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INTRODUCTION

Farm to school activities are becoming increasingly popular in the United States (US). The National Farm to School Network claims that over 40,000 schools teaching over 23 million students engage in farm to school programs (NFSN, 2015a). School gardens are one key aspect of farm to school, and researchers have examined the ways they impact how students eat, learn, and form connections with the natural world (Blair, 2009; Block et al., 2011; Cotugna, Manning, & Didomenico, 2012; Gibbs, Staiger, Johnson, et al., 2013; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Stone, 2009; Waters, 2008). Still more studies have examined aspects of effective school garden programs (Graham et al., 2005; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011; Henryks, 2011). In this introduction, I set the context for the rest of my thesis by first explaining the importance of environmental education and how farm to school and school gardens fit into it. I then describe how school gardens can act as public health interventions and review other studies on school gardens. Lastly, I discuss my research questions and goals and how my study differs from previous studies.

Environmental and Sustainability Education

Environmental education aims to teach children about the environment and the concept of sustainability to ensure that an adequate standard of living can endure over time (Louv, 2005; P. Cuming personal communication, 2014). However, in today's globalized and technology-dependent world, children are often aware of the global threats to the environment, but their physical contact and direct experiences with nature are declining (Louv, 2005). Many environmentalists believe that it is important to teach children from an early age about how they fit into the natural world and about environmental issues (Louv, 2005; Orr, 2004; Skelly & Bradley, 2007). Studies show that children who have significant and positive experiences with and education about nature are likely to be environmentally sensitive, concerned, and active as adults (Blair, 2009). Environmental education aims to teach people about the living environment and its associated problems and to motivate them to take action towards their solutions (Stone, 2009). As the great educational innovator Maria Montessori believed, "knowledge can be best given where there is eagerness to learn, so [primary school] is the

period when the seeds of everything can be sown—the child’s mind being like a fertile field [where they later] will expand and grow” (Montessori, 1948, p. 3).

Farm to School and School Garden Programs

There are numerous ways that schools incorporate environmental education into their curricula and one popular program across much of the world today is “farm to school” (Nicholson, Turner, Schneider, Chriqui, & Chaloupka, 2014). Farm to school incorporates hands-on learning into school curricula using cooking classes, school gardening and composting, and field trips to local farms (Thompson, Ghelardini, Keene, & Stewart, 2014). Federal and state governments across the US are increasingly recognizing the value of farm to school programs: in 2012 and 2013, 20 states—including Maine—passed farm to school-related legislation, and another 17 states introduced related legislation (CAFS, 2014). On the federal level, an important law pertaining to farm to school is the 2010 Child Nutrition Act Reauthorization (NFSN, 2015b). Otherwise known as the Healthy, Hunger-Free Kids Act, this Act provides a mandatory \$5 million per year in funding for the Farm to School Grant Program (NFSN, 2015a). This Grant Program is managed by the US Department of Agriculture (USDA) and aims to increase the use of and improve access to local foods in schools (CAFS, 2014). However, demand for these grants has been at least five times higher than what the USDA is able to supply, and therefore many lawmakers—led by Senator Thad Cochran (R-Miss.) and Senator Patrick Leahy (D-Vt.)—are promoting a new law, the Farm to School Act of 2015, which is further described in the Policy Recommendations section. Notably, this Act would increase annual USDA grant funding from \$5 million to \$15 million to better meet demand (NFSN, 2015a).

This thesis focuses on the school gardening aspect of farm to school. Gardening embodies many aspects of sustainability and environmental education—requiring the efficient use of resources and general knowledge of the local climate and growing conditions necessary for each individual plant (P. Cuming personal communication, 2014; Stone, 2009). The school garden program is an international phenomenon that originated in the late nineteenth century. Teachers have long used school gardens to deepen children’s knowledge of where food comes from, how to cook it, and how it

affects their bodies (Green & Duhn, 2015; Skelly & Bradley, 2007). In Australia (AUS), Stephanie Alexander—a celebrity chef who formed the Stephanie Alexander Kitchen Garden (SAKG) Foundation in 2001—has done the most to promote the school garden movement across the continent. Today the Foundation boasts a membership of over 800 schools and provides a broad range of curricular, financial, and planning resources (SAKGF, 2015).

In the US, the first documented school garden was created in 1891 (Obama, 2012), but it took World Wars I and II to encourage a large number of schools to create gardens (Figure 1). During the war years, teachers used school gardens to produce food for the war effort, to “teach children about nature, to green the industrial city, to Americanize immigrants, and to instill ethics of hard work and patriotism” (Trelstad, 1997, p. 162). Interest in school gardens dipped after World War II, but has picked up recently (Obama, 2012). Although the US lacks an influential national school garden movement like the SAKG Program in AUS, hundreds of smaller organizations across the country exist to support school gardens.



Figure 1. Poster released during World War I to encourage children to participate in gardening at school to aid the war effort (Hunziker, 2014).

In Maine, many organizations support school gardens, one of which being the Maine School Garden Network, which has 125 registered schools (MSGN, 2015). According to Ellie Libby, manager of an agricultural extension office and FoodCorps Maine, and board member of the Maine School Garden Network, “Maine has a burgeoning young farmer community [that is] very concerned about education and is community minded,” and the young farmers, along with many other community members, are supporting school gardens. Additionally, Libby believes that as more and more successful school garden programs get in the news across Maine, more schools will form garden programs of their own (E. Libby personal communication, 2015). Because Maine has such a vibrant farming community, it was an ideal place to study school gardens because the ones here can serve as models for the rest of the country.

In a typical school garden program, students raise a garden with edible plants, and then together prepare and cook meals with those foods (Gibbs, Staiger, Townsend, et al., 2013). In the school environment, there are plenty of opportunities to make connections between the classroom, the cafeteria, and the garden. School gardens and farm to school programs may also be crucial to the local food movement (J. Piotti personal communication, 2014). Some believe that school gardens increase student interest in gardening and local food, which encourages students to visit farmers’ markets with their parents, and also encourages schools to purchase food from local farmers (E. Libby personal communication, 2015; J. Piotti personal communication, 2014; Waters, 2008). Local food is so important to the Portland, Maine school district that it has created a goal of sourcing 50% of the school’s lunches locally by 2016 (R. Fahey-Dennett personal communication, 2015).

Potential of School Gardens to Improve Health and Nutrition

Schools are especially well-positioned to impact student eating habits because that is where they consume most of their meals, and over 35% of their calories, during the school year (Cotugna et al., 2012; Thompson et al., 2014). Furthermore, many people develop eating habits—and particularly involving the consumption of fruits and vegetables—as children (McAleese & Rankin, 2007; Morgan et al., 2010; Obama, 2012; Turner & Chaloupka, 2012). For the first time in two centuries, American children are

predicted to have shorter lifespans than their parents (Ramírez, 2013), and approximately 33% of elementary school-aged children are overweight or obese (Turner & Chaloupka, 2012). Previous studies have shown that school gardens can transform student eating habits and provide good, long-lasting background knowledge about the way food is produced (Guitart, Pickering, & Byrne, 2014; Morris & Zidenberg-Cherr, 2002). Nutrition education that encourages children to eat more fruits and vegetables may help prevent chronic diseases, cancer, and diabetes later in life (Guitart et al., 2014; McAleese & Rankin, 2007). School gardens can play a key role in nutrition education because they may increase children's willingness to try these foods and adopt more nutritious diets. An added benefit is that children often bring these habits and lessons home to their families and influence their eating habits as well (Hiramatsu, Kurisu, Nakamura, Teraki, & Hanaki, 2014; Stone, 2009).

Previous Studies on School Gardens

Dozens of researchers have studied school garden programs in the past decade. In addition to looking at their impacts on student nutrition, published studies on school gardens have also ranged from examining children's academic performance to their knowledge of the environment (Gibbs, Staiger, Townsend, et al., 2013). For example, several studies find that school gardens have beneficial impacts on student academic performance and encourage them to become more confident and active learners (Graham et al., 2005; Passy, Morris, & Reed, 2010; Royal Horticultural Society, 2007). Other studies find that school gardens give students greater scientific knowledge and understanding of concepts such as seasons and crop production (Block et al., 2011; Kangas et al., 2014). Lastly, some studies find that school gardens are an ideal medium to give children an awareness of sustainability (Royal Horticultural Society, 2007).

To date, comparative studies and studies on school gardens in Maine are limited, as are studies focused on school gardens and environmental sustainability. Furthermore, I believe that the scholarship on school gardens has not kept pace with the explosive growth in the school garden movement in the last decade (Williams & Dixon, 2013). Using literature reviews, surveys, interviews, and participant observation in both AUS and Maine, this thesis aims to investigate three questions: (1) How do school gardens

affect students' nutritional habits, environmental knowledge, and practices of sustainability? (2) What organizations exist in Maine and what are their roles? and (3) What factors contribute to effective school garden programs? The goals of this study are first to determine if the positive findings about school gardens apply to my two study areas, and second to help the school garden movements in both areas by identifying organizations that are available for assistance and providing a blueprint for new and existing garden programs to be as successful as possible. Throughout this study, I primarily focus on the US and use data from Australia to back up some of my claims from Maine.

METHODOLOGY

I used a variable method research design, which included: literature review, participant observation, interviews, and surveys. During the spring of 2014, I studied school gardens in Northeastern New South Wales (NSW) as the independent study project for my study abroad program in AUS and investigated two questions, “how do school gardens contribute to elementary school students' nutritional habits, environmental knowledge, and practices of sustainability?” and “in what ways can school gardens be effective and economically self-sufficient?” (Meltzer, 2014). In the fall of 2014 and spring of 2015, I expanded my study from AUS to school gardens in Maine and the US as a whole for my senior honors thesis. I obtained Human Subjects Review approval for both study areas—in AUS from the School for International Training Local Review Board, and in Maine from the Colby College Institutional Review Board. I also created two location maps using ESRI ArcGIS 10.2 (ESRI, 2011).

Study Sites

I conducted primary research in six schools in two distinct areas for this thesis: Northeastern NSW, AUS, and Central Maine, US (Table 1). Both sites were conveniently accessible to me and have several similarities. They are both English-speaking, have economies dominated by the service-sector, and are rural and agricultural. In fact, many of the students in both areas had parents who farmed. Most importantly however, both are experiencing a revival of a local food movement, which includes

school gardens (A. Vallance personal communication, 2014; E. Libby personal communication, 2015).

Table 1. Basic information about the six primary study sites for this thesis [Tuntable Creek Public School (TCPS), Main Arm Upper Public School (MAUPS), Kennebec Montessori School (KMS), Albert S. Hall School (ASHS), Troy Howard Middle School (THMS), and Medomak Valley High School (MVHS)], including location, participating grades, approximate founding, and approximate number of participants.

Location	School					
	TCPS	MAUPS	KMS	ASHS	THMS	MVHS
	Tuntable Creek, AUS	Main Arm, AUS	Fairfield, ME	Waterville, ME	Belfast, ME	Waldoboro, ME
Participating Grades	K - 6	K - 6	1 - 3	5	6 - 8	9 - 10
Founding of Program	2013	2011	2010	2013	2006	1996
Number of Participants	12	30	19	22	130	61

The state of NSW is in southeastern AUS, contains 6.6 million people, and spans 310 thousand square miles (MyRegion, 2014). NSW has a generally mild climate and is reliant on mining, tourism, and agriculture, growing wheat, maize, oats, barley, rice, tobacco, vegetables, oranges, apples, peaches, and sugar cane, as well as meat, wool, and dairy (Helicon, 2014a). Tourists flock to NSW for its swimming, surfing, fishing, and whale-watching (P. Cuming personal communication, 2014). The particular region I studied in Northeastern NSW is regarded as one of the state's most beautiful regions due to its coastline, 20 national parks, vibrant town centers, and important farmland and forest areas (NSWGDP, 2006). Although the region has valuable natural features, the population is generally socially disadvantaged and particularly vulnerable to rising food costs (SNR, 2013). As of June 2012, the population of 300,000 had a 10% higher unemployment rate and a 10% lower mean income compared to state and national averages (MyRegion, 2014). Major sectors of the economy include agriculture, forestry, fishing, tourism, services, manufacturing, and construction (NSWGDP, 2006). Because the region's economy is so dependent on the natural landscape, residents there tend to value the environment more than the average AUS population (NSWGDP, 2006). Many families have their own gardens, compost, recycle, collect rainwater, conserve energy, and participate in environmental activism (P. Cuming personal communication, 2014). Furthermore, as of April 2015, there were 223 school gardens in the state registered with the Stephanie Alexander Kitchen Garden (SAKG) Foundation (SAKGF, 2015). While

focusing on the entire Northeastern NSW region, I chose two schools to study in-depth, each of which is explained below (Figure 2). Both of these schools had school gardens, were recommended to me by my project advisor, and agreed to let me study them.

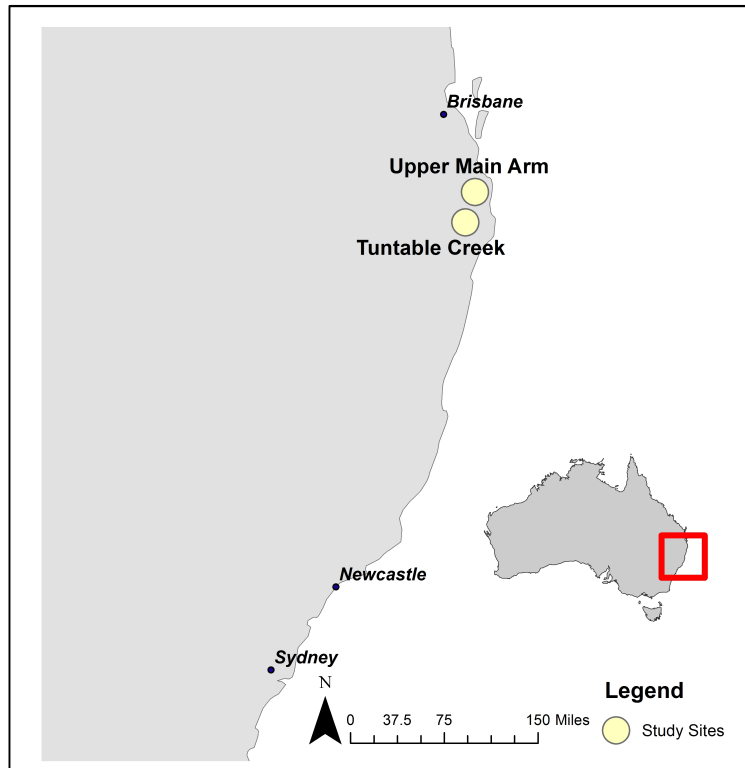


Figure 2. The two AUS towns of the schools chosen for this study: Main Arm Upper Public School (MAUPS) and Tuntable Creek Public School (TCPS). The cities of Brisbane, Newcastle, and Sydney are included for reference.

Maine is inhabited by 1.3 million people and spans 31,000 square miles (USCB, 2013). The service industry dominates the economy, but farming, fishing, lumber, manufacturing, and shipbuilding are also important. The largest exports include paper and pulp, wood products, textiles, potatoes, blueberries, and apples (Helicon, 2014b). Tourists travel to Maine from all over the world, but especially from the local New England region. Recreational activities includes hunting, fishing, hiking, skiing, and boating, and catering to these tourists is what drives the economy (J. Thurston personal communication, 2015). Despite Maine's harsh winters and rocky soil, the state is fairly rural and agriculturally dependent, and is a major exporter of blueberries, potatoes, and dairy (Helicon, 2014b). Although agriculture is very important to the Maine economy, like in Northeastern NSW, there is an extremely high level of food insecurity and

socioeconomic disadvantage due to factors like a shortage in livable wage jobs, high heating and housing costs, an elderly population with expensive healthcare needs, and a location at the end of US trucking routes (Love, 2014). Fifteen percent of Maine residents and 25% of Maine's children are food insecure, meaning they lack convenient access to fresh, nutritious food, and the statewide average of students on free and reduced price lunches is 46% (Love, 2014).

Similar to NSW, Maine has a burgeoning local food and school garden movement, with 125 gardens registered with the Maine School Garden Network as of April 2015 (MSGN, 2015). There were only four registered school gardens in 2010 and 107 in 2014, so the numbers are growing fairly rapidly (Love, 2014). Massachusetts, comparatively, which has almost five times the population of Maine, had only 89 school gardens in 2011 according to Massachusetts Agriculture in the Classroom (MassAITC, 2011). While my research spanned the entire state, I chose four schools to study in-depth in the Central Maine region (Figure 3), which are each explained below. All four of these schools had school gardens, were recommended to me by my interviewees, and agreed to let me study them.

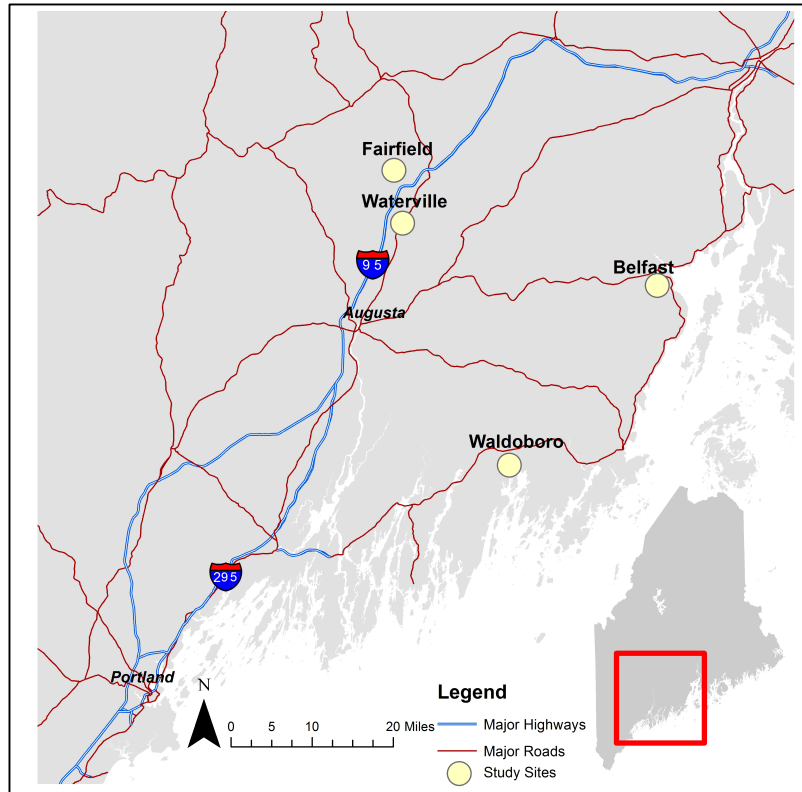


Figure 3. The four towns of the Maine schools chosen for this thesis: the Waterville Albert S. Hall School (ASHS), the Fairfield Kennebec Montessori School (KMS), the Belfast Troy Howard Middle School (THMS), and the Waldoboro Medomak Valley High School (MVHS). The cities of Portland and Augusta are included for reference.

Study Site 1: Tuntable Creek Public School (TCPS), Tuntable Creek, NSW, AUS

The first school I studied, TCPS, is a small school in the small, rural AUS community of Tuntable Creek. At the time of my visit, the school was made up of only one class of 11 students, ranging from kindergarten through sixth grade, with students from 6 through 12 years old. There were only two full-time staff members at the school—the teacher principal Alison Bath and the school administrative manager—and four part-time staff members. Environmental sustainability is important at TCPS (TCPS, 2014); in addition to having solar panels and rainwater collection, the school has several well-established fruit trees, and has had a small garden for at least ten years. In 2013, when TCPS applied for and gained membership to the SAKG Program, the school greatly expanded both the size of their garden and its inclusion within the curriculum (A. Bath personal communication, 2014). Bath primarily runs the garden program, but is assisted by other teachers when cooking, gardening, and using online tools. Additionally, the

school's general assistant created most of the infrastructure the garden requires. Aside from the several established fruit trees, the school has a chicken and rooster, several beds of vegetables, and has plans to build a greenhouse. Since there is only one class at the school, every student participates in the garden program. Although there are few kitchen accessories, the students have access to the staff and canteen kitchen for preparation of school lunches.

Study Site 2: Main Arm Upper Public School (MAUPS), Upper Main Arm, NSW, AUS

MAUPS is another small school in the region, located in the small rural AUS community of Main Arm. The school also runs from kindergarten through sixth grade, but since there are about 80 students at the school, they are able to have four different classes and several more full-time staff than TCPS. Like TCPS, sustainability is a core theme throughout the school grounds and curriculum. The goal of the MAUPS garden program is to teach students healthy eating habits through cooking, along with allowing students to connect science, literacy, and math with sustainability through gardening (MAUPS, 2014). Although MAUPS has had a school garden program since 2009, cooking began in 2013 as they were gaining membership to SAKG Program. Christian Tranberg, the fourth through sixth grade teacher who spearheaded the creation of the school garden program, wants students to learn about sustainability through educational opportunities in the garden (C. Tranberg personal communication, 2014). Tranberg and the garden coordinator, Cass Curran, primarily run the garden program. Although every class year cooks, only the upper level grades work in the garden. Additionally, there is a popular Garden Club, made up of students from all class years, which takes care of the daily gardening tasks during lunch and recess periods (C. Curran personal communication, 2014). At the time of my visit in April 2014, they used a portable kitchen with only basic equipment, but had plans to build a permanent, well-equipped one in the near future. The garden consists of 12 raised beds and several fruit trees but they were in the process of adding a greenhouse, and were planning on adding native beehives, a chicken pen, and a complex composting system to their program.

Study Site 3: Albert S. Hall School (ASHS), Waterville, ME, US

ASHS is the public fourth and fifth grade school for the city of Waterville, Maine. Out of 232 students at ASHS, 64.2% qualify for free lunch (households with incomes that are 130% of the poverty level) and 11.2% qualify for reduced-price lunch (households with incomes that are 185% of the poverty level) (Maine Department of Education, 2014). The garden program at ASHS is relatively new and small. As of 2015, out of 232 students, only one class of 16 and the 7 member Garden Club participate in the program. However, the science leader, a fourth grade teacher who develops science curriculum, is planning to integrate gardening activities into the science curriculum in all classes at the school that are based on national science standards (M. Dunn personal communication, 2015).

At the time of my visits, ASHS had two indoor grow-light stations, five garden beds and several small patches of flowers. The garden program at ASHS consists of activities ranging from learning about tomatoes (dissecting them, exploring their anatomy, preserving their seeds, and testing their viability through scientific experiments) to planting daffodil bulbs in their garden. Gardening is difficult at the school because the entire school ground is covered with blacktop, but an anonymous donor recently provided the funds to build a new, extensive, and fenced-in garden with raised beds to be built in the spring of 2015 (M. Dunn personal communication, 2015).

The donation came shortly after the “onion incident” in September 2014 when someone stole a bed of onions planted at the school. News of the onion theft was first published in the Portland Press Herald (Calder, 2014), then was spread throughout the state and country by news agencies such as ABC News, USA Today, and the Miami Herald (Diebel, 2014). The school began receiving onion donations by the hundreds—although no more than a hundred had been stolen, the students ended up with over a thousand onions that they then donated to local homeless shelters, food banks, and soup kitchens. The school also received dozens of letters from across the country, some of which contained monetary donations for the program; Mary Dunn, who runs the program, estimates that the incident brought in \$1,000 in donations. Coincidentally for the school, the onion incident came at a time when the garden program was really getting started and

helped the school garden earn media attention, which may help draw support from both in and outside the school to allow the program to continue to grow.

Another key component of the garden program at ASHS is monthly taste tests for all students in the school. Every month, a local food co-op brings some in-season, local food for students to try. In addition to being a component of the garden program, the taste tests also fit into the goals of the ASHS Wellness Board, which is composed of teachers and staff at the school as well as community members. The Board meets monthly to discuss ways to improve the health and nutrition of ASHS students, which includes the school garden, the monthly taste tests, and the “5-2-1-0” initiative, which advocates for children eating five servings of fruits and vegetables a day, limiting screen time to two hours a day, getting one hour of exercise a day, and consuming zero sugary drinks.

Study Site 4: Kennebec Montessori School (KMS), Fairfield, ME, US

KMS was the only non-public school in my study. The school includes day-care through third grade and is located in the town of Fairfield, Maine, which borders Waterville. KMS follows the Montessori Method, which among other things, “awakens children’s love for environment [since] environmental protection by itself is one of the basic elements of Montessori education” (Durakoglu, 2014, p. 311). Although KMS offers some financial aid, the school is largely composed of children from the Greater Waterville area who come from middle and upper class backgrounds. Since it is a private school and does not participate in the National School Lunch Program, free and reduced price lunch statistics are not available. However, simply accounting for the fact that students have to pay for tuition and do not receive any funding for school meals, the average student at KMS is likely from a higher-income household than the average student at ASHS or my other four study sites.

Also—unlike at ASHS, where many students were gardening for the first time—many KMS students garden at home, frequent farmers’ markets, and are otherwise involved with the local food scene (L. Butera personal communication, 2015). According to a head teacher there, “many of the students: come from families that talk about nutrition and have their own gardens, eat very healthy, and...have rich cultural backgrounds about food and nutrition” (L. Butera personal communication, 2015). The

school is in a rural setting, surrounded by forests and farmland. KMS has had a garden for ten years that was maintained by parent volunteers until 2013, when a staff member expanded the garden area and began teaching associated lessons (L. Butera personal communication, 2015). Near the school are a fruit tree orchard, five beds of vegetables, and a few raised beds of flowers. The school also has a well-maintained trail system to use for the outdoor classroom, which is where the school garden comes into play. Each day, the assistant teacher brings a group of four students outside to teach lessons, which often revolve around the garden and orchard during the fall and spring. During my visits, the outdoor classroom session included composting food scraps, harvesting vegetables, checking the status of the fruit orchard, finding and discussing the science behind different types of seeds in their garden and forest, learning about ecosystems using the garden and nature trails, and writing poems using objects located around the garden and trails.

Study Site 5: Troy Howard Middle School (THMS), Belfast, ME, US

THMS was my third Central Maine study site. Like at ASHS, there is widespread poverty in the Belfast area, where THMS is located. Out of 364 students, 51.4% qualify for free lunch, and 5.2% qualify for reduced-price lunch (Maine Department of Education, 2014). THMS is made up of three academies: Ecology, Innovation, and International. The THMS garden program, which is a centerpiece of the Ecology Academy, is called the “Garden Project.” It is designed to teach students about science, math, technology, and social studies while producing healthy food and interest in sustainability action (Stone, 2009). According to the Project’s website,

[the garden] grows empowered, academically successful young people. Students learn to integrate sustainability into their lives by producing and learning to satisfy their needs locally. Our mission is to create a district wide agricultural project that promotes healthy living through practical applications... We strive to integrate the school and its land with the community. Our goal is to engage all students in a journey of discovery through gardening projects that meet science, math, language arts, economics, and social studies Maine Learning Results. Our young people are excited by making a real difference in their school and community. (THMS, 2015)

In the Ecology Academy, which has about 130 students, the seventh and eighth graders go to the garden every week, while the sixth graders go every other week. In groups

ranging from 5 to 25, Jon Thurston, who runs the program, brings the students out to the garden, local trails, and streams. The garden itself is composed of a half-acre outdoor garden, multiple compost bins, a stand-alone kitchen building, a greenhouse, two hoop-houses, and a garden stand. In the greenhouse, there are multiple raised beds, a rabbit, a hen and rooster, and a fishpond that provides nutrients to feed the garden. The students bring out buckets of compost from every lunch period and work it into their compost bins, which provides all of the needed soil (J. Thurston personal communication, 2015).

Cooking and eating the food they grow is also a large part of the program. The cafeteria serves food from the garden and the students have access to the former home-economics kitchen, as well as the kitchen in a stand-alone “eco-building” next to the greenhouse to cook for themselves (J. Thurston personal communication, 2015). This building uses passive solar design, solar-powered radiant flooring, and other innovative renewable energy designs to teach students about green buildings. When I visited the site, the students’ primary task was to weed the spinach and chard beds, which had just been harvested for sale at the local co-op. They also made geranium cuttings and fed compost to the worms in one of the unheated hoop houses.

Study Site 6: Medomak Valley High School (MVHS), Waldoboro, ME, US

The fourth school I studied in Maine was MVHS. Out of 550 total students, 38% qualify for free lunch, and 8% qualify for reduced-price lunch (Maine Department of Education, 2014). Similar to THMS, the garden program at MVHS is extensive and well known. Two people started the program in 1995: Jon Thurston—who later started the program at THMS—and Neil Lash, who still runs the program today. Unlike many of the other schools I studied, which used the garden as more of an add-on to existing courses, the garden program at MVHS forms the entire basis of specific science electives at the school—Horticulture I and II. In Horticulture I, students learn the basics of growing plants and taking care of them in the greenhouses. In Horticulture II, students take charge of the Heirloom Seed Project, which was celebrating its 20th year anniversary at the time of my visit. With over 800 heirloom varieties, the class breeds and sells seeds to seed companies, Native American tribes, and individuals worldwide.

Although the Heirloom Seed Project is a full-fledged business, much of the program involves learning about the history and culture behind seeds and foods. As a

part of the program, students decide which seeds they want to order, which have to be ones that they do not have already and have historical value. People also send seeds to the program, coming from as far as Cape Town and Brazil. To Lash, all seeds have a story for students to learn and the program is about making connections between history, seeds, trees, culture, and families. For example, they have several varieties that come from George Washington's Mount Vernon and Thomas Jefferson's Monticello. According to Lash, this program is the first and only high school in the country with a yearlong seed-saving program (N. Lash personal communication, 2015). According to its website,

We would like to locate as many locally grown, open pollinated seeds as possible. Many of our seeds have been passed down from generation to generation and provide a wealth of information, memories and history. We want to collect, document, and share these memories before they are lost and forgotten. [Another major purpose of the program] is saving seeds to promote biodiversity. The unique genetic makeup of these seeds is the result of forces and situations that will never again be duplicated. Whatever interesting qualities in the plant's taste, aesthetics, disease-resistance, or ability to grow in [Central] Maine, they are lost if the seeds are not passed on for others...to perpetuate. (MVHS, 2015)

Most of what the students grow is for seed and not for food, but like at THMS, they do serve a lot of what they grow in the cafeteria. Additionally, some of the most popular events at the school are pizza parties with dough and vegetables prepared, grown, and cooked by students in the program's pizza oven.

Literature Review

I conducted two literature reviews for this thesis—one focusing on AUS school gardens, and another one focusing on those in the US. Using the online academic database Scopus/Science Direct and the search terms “school gardens,” “school kitchen gardens,” “child nutrition,” “environmental education,” and “farm to school,” I reviewed 18 relevant journal articles for AUS and 31 for the US. I also reviewed the websites of 15 relevant organizations in AUS and 23 for the US. Lastly, I reviewed four relevant books for AUS (Dollard, 2012; Montessori, 1948; SAKGF, 2012; Shiva, 2008) and five for the US (Alexander, 2010; Louv, 2005; Obama, 2012; Stone, 2009; Waters, 2008).

Participant Observation

The second method I used in my study was participant observation. For a period of three weeks in the spring of 2014 in AUS, I conducted participant observation at TCPS and MAUPS. Then, for seven weeks in the fall of 2014, I conducted participant observation at two US schools—ASHS and KMS. Finally, in January 2015, I conducted participant observation at THMS and MVHS. During participant observation, I observed the programs, asked questions, and tried to “uncover the meaning behind the behaviors” of those I was observing (Guest, Namey, & Mitchell, 2013). I kept written notes during each visit to the schools, and then compiled more detailed notes after each visit. At each school I studied, I helped students with their assignments and asked exploratory questions to gauge if they were interested, curious, and knowledgeable about what they were doing. Throughout the whole observation period, I explored how effective I thought the gardens were and how they affected the students’ behaviors and attitudes. I also collected information from the teachers and garden coordinators about the school, the town, the children, and the gardens. I developed a set of components that appear to be responsible for effective school gardens, and then ranked my six study sites based on how many of these components their programs had at the time of my visits (Table 3). For the portion of my study in Maine, I also attended two conferences on the topic of school gardens: the November 2014 Maine Farm to School Conference in Ellsworth and a School Garden Regional Gathering in Wiscasset in February 2015. Each event is explained further in the Results section on organizations in Maine.

Interviews

In the spring of 2014, I interviewed teachers, volunteers, and experts to learn more about their experiences with and opinions of AUS school garden programs, and then in January 2015, I interviewed similar stakeholders in the US. I conducted my first interviews with teachers and administrators from my six study sites and then used their recommendations to identify other key stakeholders to interview. All but two people I requested an interview from agreed to an interview, but I do not think this affected my results. One of those people deferred to another stakeholder I interviewed and the other never responded to my request. The people I interviewed included:

- Alison Bath, Principle/Teacher at TCPS (AUS)

- Kathleen McMahon, Administrative Manager at TCPS (AUS)
- Christian Tranberg, Teacher at MAUPS (AUS)
- Cassie Curran, Garden Coordinator at MAUPS (AUS)
- Ainslee Vallance, Program Research and Development Manager at the Stephanie Alexander Kitchen Garden Foundation (AUS):
- Ellie Libby, Extension Educator, State Supervisor for FoodCorps Maine, and State Co-Lead for National Farm to School Network (US)
- Ryan Fahey-Dennett, Coordinator of the Maine School Garden Network (US)
- Willie Grenier, Director of Maine Ag in the Classroom (US)
- Danielle Fleury, Northeast Staff Member at the USDA Food and Nutrition Service's Farm to School Program (US)
- Jon Thurston, Teacher and School Garden Coordinator at THMS (US)
- Neil Lash, Teacher and School Garden Coordinator at MVHS (US)
- Susan Holmes, Teacher at KMS (US)
- Laura Butera, Teacher at KMS (US)
- Mary Dunn, Teacher at ASHS (US)

Using a semi-structured format, I asked each interviewee 11 qualitative questions (Appendix I), taking brief notes during the interviews, and then compiling more extensive notes after each interview was complete. Each interview lasted about half an hour and was carried out like a normal conversation, in which I made sure touched on every question. I conducted the AUS interviews in-person, and although I met most of my Maine interviewees, I conducted each interview over the phone.

Surveys

In the spring of 2014, I administered a survey to a nonprobability sample of 30 students at my two AUS study sites with garden programs and received 12 completed ones (40% response rate). For the next portion of my study, in the fall of 2014, I administered a slightly modified version¹ of that survey to nonprobability samples of (a) 49 students in three of my study sites in Maine with garden programs (KMS, ASHS, & THMS) plus (b) 21 students at one elementary school in Waterville (the George J. Mitchell School) that did not have a formal garden program² (Appendix II). I received 28

¹ I modified several questions in my survey for US students using lessons from AUS. Although these modifications strengthened my survey, they made it so I could not directly compare all questions from AUS to questions from the US and vice versa.

² I administered surveys to a class at ASHS that did not participate in the garden program, but received no responses. Therefore, I surveyed a third grade class at the Mitchell

completed surveys from this group (40% overall response rate): 15 from students who participated in garden programs (31% response rate) and 13 from students who did not (62% response rate). Combining my surveys from AUS and the US, I had 27 from students who did garden and 15 from students who did not garden. It is important to note that this was not a representative sample – the students I surveyed were chosen for convenience and accessibility: they were the ones who were in the classes of the teachers I had contact with. Therefore, my survey responses may reflect systematic biases and not be representative of the greater population (with regard to age, gender, grade level, teachers, time spent in garden, etc.) as a random sample would, which is why I put greater weight on results from my literature review, interviews, and participant observation than on my surveys.

The survey instrument had five qualitative and five quantitative questions (Appendix II). I performed statistical analysis on much of my survey results using Stata 13 (StataCorp, 2013). I was able to use my survey results for these analyses from both the US and AUS for all but one question (daily consumption of fruits and vegetables) because of the modifications. Due to my small sample size, I performed nonparametric “Wilcoxon-Mann-Whitney tests” for non-binomial data, and “Fisher’s exact tests” for binomial data to determine if there were statistically significant differences between students who did and did not participate in garden programs with regards to their (1) nutritional habits (binomial data: either the student did or did not eat fruits and vegetables daily), (2) ability to define “sustainability” (binomial data: either the student could or could not define sustainability), (3) future desired sustainability-related practices (binomial data: either the student did or did not want to pursue each activity in the future), (4) knowledge of “garden-related terms” (non-binomial data: how many out of ten terms each student selected), and (5) proficiency of “garden related skills” (non-binomial data: how many out of six skills each student selected). I broke these data up by

School. Although this changed multiple variables (garden participation, school, and age) the students at the Mitchell School also live in Waterville and go to the Hall School after they graduate. Additionally, the average age of the students I surveyed at the Mitchell School is similar to that of the students I surveyed who did participate in garden programs.

the three categories of my first study question—nutrition, environmental knowledge, and sustainability practices—and display them in Table 2. Due to timing and logistical constraints, my survey did not test children over time, so I could not directly use the survey data to see if participation in school garden programs *improves* students’ nutrition, environmental knowledge, and sustainability practices.

RESULTS AND DISCUSSION

This section is broken up into three parts based on my three study questions. First, I present the results of my participant observation, interviews, and surveys as they pertain to student nutritional habits, environmental knowledge, and sustainability practices. Second, using information from my participant observation and interviews, I examine some of the primary organizations supporting school gardens in Maine. Third, I evaluate some of the major factors that go into successful school garden programs.

Nutrition, Environmental Knowledge, & Sustainability

For each of the three topics I explored—nutrition, environmental knowledge, and sustainability—I describe my survey results (Table 2) and then my participant observation and interview results, and lastly I discuss whether or not these results support those from previous studies. I want to clarify again that my survey results were based on small, non-random samples, and it is quite possible that students did not understand some of the questions. Additionally, upon further reflection of my survey results, it seems like many of the students may not have understood some of the questions and terminology. Therefore, I use my interview and participant observation results to either validate or refute my findings from my surveys.

Table 2. Survey results comparing 1st-7th graders who participated in garden programs at five schools [Tuntable Creek Public School (AUS), Main Arm Upper Public School (AUS), Albert S. Hall School (US), Kennebec Montessori School (US), and Troy Howard Middle School US)], and 3rd graders who did not participate in garden programs [George J. Mitchell School (US)].

Survey Question	Garden Participants		Non-Gardening Participants		P - Value
	<i>N</i>	%	<i>N</i>	%	
	<hr/> (N = 15)		<hr/> (N = 13)		
NUTRITION					
Daily Consumption of Fruits and Vegetables	9*	60	2	15	0.024
	(N = 27)		(N = 13)		
SUSTAINABILITY					
Ability to Define	12	44	4	31	0.503
	(N = 27)		(N = 13)		
<i>FUTURE DESIRED PRACTICES</i>					
Gardening	24*	89	7	54	0.038
Caring for the Environment/Recycling	23*	85	6	46	0.020
Shopping at Farmers' Markets	21	78	6	46	0.072
Composting	20	74	6	46	0.155
	<hr/> <i>Mean Score</i>		<hr/> <i>Mean Score</i>		
	(N = 27)		(N = 13)		
ENVIRONMENTAL KNOWLEDGE					
Proficiency of Garden-Related Skills (out of 6)	3.81		2.62		0.054
Knowledge of Garden-Related Terms (out of 10)	4.52		3.77		0.391

*Significance at $p < 0.05$

Nutrition

My survey results showed that US students who participated in garden programs were significantly more likely to eat fruits and vegetables daily than students who did not ($p=0.024$). While 60% of the students who did participate in a garden program ate fruits and vegetables daily, only 15% of the students who did not participate in a garden program ate fruits and vegetables daily. Through my participant observation, I observed that most student participants became more adventurous eaters and more aware of proper nutrition through school garden programs. Students were trying foods they grew directly from the garden and the foods that they cooked. I also observed several lunch periods and heard students talk about the nutritional lessons they learned during the garden program. Many also ate foods similar to those that they grew and cooked during the garden program. Additionally, a few of my interviewees believed that school gardens have the potential to encourage entire families to adopt more nutritious diets. For

example, according to Ryan Fahey-Dennett, the coordinator of the Maine School Garden Network, “I’ve heard stories of students asking their parents for vegetables the parents didn’t know existed, and stories of kids and parents bonding when the kids bring home [vegetables] and show their parents how to cook it and it becomes something they buy every week” (R. Fahey-Dennett personal communication, 2015).

My survey results are consistent with other studies that claim that gardening improves students’ nutrition (I used daily consumption of fruits and vegetables as a proxy for nutritious diets). Also, results from my participant observation and interviews were consistent with other studies that reported that garden programs shift children’s eating habits towards more healthful foods (Gibbs, Staiger, Johnson, et al., 2013; Parmer, Salisbury-Glennon, Shannon, & Struempfer, 2009).

Environmental Knowledge

My survey data are not consistent with studies finding that gardening is an effective way to teach students about the environment. Students who participated in garden programs were no more likely to be proficient in “garden-related skills” (growing food in a garden, identifying seasonal changes, preparing food, identifying fruits and vegetables, working with other students, and protecting the earth) than students who did not ($p=0.054$). Also, students who participated in garden programs were no more likely to have knowledge of “garden-related terms” (water conservation, fertilizer, climate change, processed food, permaculture, local food, organic, whole foods, food deserts, and pesticides) than students who did not ($p=0.391$). I designed these two questions using “garden-related skills” and “garden-related terms” as proxies for being environmentally aware, competent, and knowledgeable. However, upon further reflection, these questions did not seem to really test environmental knowledge, but rather garden knowledge. Even so, the students who gardened did not have more “garden knowledge” than students who did not garden, which suggests to me that the students did not really understand the questions.

The students I observed, however, appeared more engaged and enthusiastic during the garden program (especially when they were outside and/or learning practical skills), than they were in the standard indoor classroom setting. Both Lash (of Medomak Valley) and Thurston (of Troy Howard) believe that garden programs are ideal settings to teach

students about the environment. For instance, Thurston teaches students about climate change and the greenhouse effect through the garden's greenhouse. They both use their garden programs to teach students about environmental concepts and issues, and how the students can work towards solving them (J. Thurston personal communication, 2015; N. Lash personal communication, 2015). In the standard classroom setting, it is more difficult to show students ways to fight environmental problems, which both Thurston and Lash do in their programs. For instance, through his garden program, Lash emphasizes the opportunities to benefit the environment, both literally and symbolically, through saving seeds. My survey, participant observation, and interview results support the studies that find school gardens improve student's knowledge of the environment (Green & Duhn, 2015; Skelly & Bradley, 2007).

Sustainability Practices

To test students' "sustainability practices," I asked two different questions on my survey: the first question asked students to define sustainability and the second question asked students which actions related to sustainability they planned on incorporating into their future lives (gardening, caring for the environment or recycling, shopping at farmers' markets, and composting). I hypothesized that if the school gardens were effectively teaching students about sustainability and how to incorporate it into their lives, that students would have a good definition of the term and would want to pursue many of these actions in the future. Using these two questions as proxies, my survey data were inconclusive as to whether or not school gardens encourage students to incorporate sustainability into their lives. Although the students who participated in school garden programs were significantly more likely to desire to garden ($p=0.038$) and care for the environment or recycle ($p=0.020$) in the future than students who did not, they were no more likely to desire to shop at farmers' markets ($p=0.072$), or compost ($p=0.155$). Furthermore, students who participated in garden programs were no more able to define the term sustainability than students who did not ($p=0.503$). According to these data, school gardens do not seem to be very effective at teaching sustainability to students. However, as with other questions on my survey, it is likely that my questions on

sustainability were not effective at evaluating students' concepts and practices of sustainability.

Looking at my interviews and participant observation, there was evidence that school garden programs were teaching sustainability. For instance, at Troy Howard, there are several examples of sustainable living in their garden program, such as passive solar heating, and other renewable technologies like using cans and solar thermal panels to heat the kitchen, and using solar photovoltaic panels to produce electricity (J. Thurston personal communication, 2015). Additionally, when I interviewed Thurston, he believed that when students get their hands dirty gardening, the desire to garden would stick with them for the rest of their lives and encourage them to eat healthy as adults. Lash also believes that the students who engage in his classes will garden for the rest of their lives and that by saving, growing, and cooking heirloom vegetables, which embody sustainability, the students will do whatever they can to ensure these seeds and vegetables last.

So, while my surveys did not, my interviews and participant observation supported the claims that growing and cooking foods at school teach students the value of local foods and other aspects of sustainability (Carlsson & Williams, 2008; Green & Duhn, 2015; Hiramatsu et al., 2014; Stone, 2009). I suspect that the reason why my survey results did not show that students who gardened had a better grasp of sustainability than students who did not was because of my small sample size and awkward wording of questions, and not so much because the schools were ineffective at teaching sustainability.

Organizations Supporting School Gardens in Maine

Through my participant observation, especially at the Maine Farm to School Conference and Regional School Garden Gathering, I learned that Maine has a rich network of organizations and schools to support school gardens. There are dozens of such organizations and below I describe seven specific ones including: the Maine School Garden Network, the Maine Farm to School Network, Maine Ag in the Classroom, FoodCorps, the Maine Organic Farmers and Gardeners Association, FARMS, and the Flannel Shirt Fund. These organizations are important because my literature review and interviews revealed that schools are most likely to form and utilize garden programs if

they have support from other schools and regional organizations (Hazzard et al., 2011; R. Fahey-Dennett personal communication, 2015; Williams & Dixon, 2013).

Maine School Garden Network (MSGN)

MSGN is a fairly new organization that is climbing to the forefront of the school garden movement across Maine. According to the organization's website, it is a

group of volunteers who believe in the value of teaching children to grow, cook, and enjoy healthful food...Our mission is to encourage, support, educate and connect those who wish to garden with youth...Our board members are educators, farmers, graduate students, nutritionists, and landscapers [and] since we came together in 2008, we have focused our efforts on teacher education and support, raising public awareness of the benefits of school garden programs, and networking with like-minded organizations around the state. (MSGN, 2015)

In an interview with Ryan Fahey-Dennett, the coordinator of this organization, she explained to me that one of the largest gaps she found in the Maine school garden movement was a lack of support and collaboration among school gardens across the state. To combat this issue, MSGN secured a grant from the Quimby Family Foundation to facilitate 16 regional gatherings in 2015 to allow school garden stakeholders to meet with each other, to share successes and challenges, to troubleshoot, and to brainstorm (R. Fahey-Dennett personal communication, 2015). The first of these networking events, or "Regional Gatherings," was composed of about 30 people, ranging from teachers to administrators to volunteers. There were also representatives of several organizations, including MOFGA, FARMS, FoodCorps, and the Maine Farm to School Network (all of which are explained below). To me, the event seemed like a major success, and not only accomplished the goal of allowing schools to network and share best practices, but also invigorated the school garden movement in this area and increased everyone's drive and passion to see it grow.

Maine Farm to School Network

The Maine Farm to School Network—which is an offshoot of the national organization—focuses not just on school gardens, but also on other agricultural activities like cooking and farm field trips, and purchasing foods from local farms for school meals. According to the National Farm to School Network's website, "Farm to school enriches the connection communities have with fresh, healthy food and local foods ...[and]

empowers children and their families to make informed food choices while strengthening the local economy and contributing to vibrant communities” (NFSN, 2012). The organization works as “an information, advocacy and networking hub for communities working to bring local food and agriculture education into school systems and preschools” (CAFS, 2014). The Maine State chapter is made up of individuals from across the state and several nongovernmental and governmental organizations. The Maine Farm to School Network is also the primary organizer of the annual Maine Farm to School Conference. This conference brings together teachers, volunteers, and administrators from across the state as well as organizations from across New England. Like the Regional School Garden Gathering, this event seemed like a major success, allowing schools and organizations to network and share best practices as well as adding energy to the farm to school movement.

Maine Ag in the Classroom (MAITC)

MAITC is at the forefront of creating lesson plans and facilitating professional development courses about agriculture in Maine. With the support of the Maine Department of Agriculture, MAITC aims “to help students gain a greater awareness of the role of agriculture in the economy and society so that they will become citizens who support wise agricultural policies and local agriculture endeavors” (MAITC, 2014). According to Willie Grenier, who directs MAITC, the goal of the program is to teach children in Maine where their food comes from and how important agriculture is to the state. MAITC is a quasi-governmental program funded by specialty agricultural Maine license plates. With these funds, they award \$60,000 in grants every year, facilitate professional development activities, and create curriculum. Through the grant programs and professional development trainings, MAITC reaches about 80,000 students in the state (out of about 180,000 total students) (W. Grenier personal communication, 2015). A similar educational resource for teachers, also created by Grenier, is “Teach ME About Food and Farms.” Like MAITC, it is a collection of resources and lessons for primary school teachers that meet the Maine Learning Results and Common Core Standards (TeachME, 2014).

FoodCorps Maine

Another important organization for school gardens in Maine is FoodCorps, which is “a nationwide team of AmeriCorps leaders who connect kids to real food and help them grow up healthy. Working under the direction of local partner organizations, we implement a three-ingredient recipe for healthy kids,” including hands-on lessons about food and nutrition, school garden and cooking classes, and local foods for lunch (FoodCorps, 2013). Ellie Libby, who is also the state lead for the Farm to School Network, directs FoodCorps Maine. In my interview with her, she said that there are:

12 FoodCorps Service members throughout the state who are working directly with schools doing taste tests, building and tending school gardens, and doing food and agricultural education in classrooms. They then leave those lessons and activities for the teachers who come after them, or for that same teacher to do that next year. It is a way to have the teachers experience directly what we want them to be doing in the gardens. Those FoodCorps members also get to learn from the experiences of those teachers who have been in the classroom for a lot longer than they have. (E. Libby personal communication, 2015)

Maine Organic Farmers and Gardeners Association (MOFGA)

MOFGA is one of the oldest and most well known organizations in the country that focuses on organic agriculture and rural living. Although school gardens are not a main focus of MOFGA, the organization is heavily involved with almost everything to do with sustainable agriculture in the state. MOFGA is a key supporter of the Maine School Garden Network and has a few programs and resources of its own related to school gardens. One such program is the annual Maine Harvest Lunch, in which school districts across the state feature local foods on their lunch menus for an “educational and community-building event,” which often encourages schools to purchase food from Maine farms and food producers year-round (MOFGA, 2014).

Focus on Agriculture in Rural Maine Schools (FARMS)

FARMS, which is small compared to the organizations above, was created in 2004 by a group of volunteers, teachers, administrators, food service staff, and farmers. It promotes healthy, local food choices in Lincoln County Maine (which includes Medomak Valley). FARMS’ mission is to:

provide education about good nutrition and the role of local farms in promoting

healthy, sustainable communities; to promote and facilitate farm to institution purchasing and provide guidance and support to families that will increase the household consumption of locally grown produce; and to offer hands-on experiences for people of all ages to develop expertise in cooking and gardening and a passion for healthier living. [We also] provide a place where local farmers, chefs, medical practitioners, and other community members can share their own knowledge and expertise. (FARMS, 2015)

FARMS recently created a “community kitchen” to host school field trips, camp programs, and cooking classes.

The Flannel Shirt Fund

The Flannel Shirt Fund, which is also a comparatively small organization, contains hard-working volunteers who dedicate time and money to support school gardens across Maine. The Flannel Shirt Fund was created by the mother of a young man who was passionate about gardening (and who wore a lot of flannel shirts). The “donor-advised” fund gives modest grants of around \$400 to support school gardens and greenhouses, local food purchases, farm field trips, and presentations on sustainable agriculture (Maine Initiatives, 2012). So far, the Flannel Shirt Fund has provided 46 grants to school gardens across Maine.

Factors Contributing to Effective School Gardens

Through my interviews (E. Libby personal communication, 2015; R. Fahey-Dennett personal communication, 2015; W. Grenier personal communication, 2015) and literature review (Gibbs, Staiger, Townsend, et al., 2013; Hazzard et al., 2011; Henryks, 2011; Williams & Dixon, 2013), I developed a set of 11 components that appear to be responsible for effective school garden programs. These eleven components were each cited multiple times and indeed seemed important to me when observing the schools. Through my participant observation, I then kept track of which school garden programs contained which of these components, and recorded them in Table 3.

Based on the 11 criteria, the Troy Howard Middle School ranked the highest followed by the Medomak Valley High School and Main Arm Upper Public School; each of these schools incorporated more than two thirds of these criteria into their garden programs. I suspect that these schools ranked the highest because they had the most well established programs and had significant administrative support. Although the number of

components met does not necessarily translate into the “effectiveness” of programs, that is how I refer to the schools throughout the rest of my thesis. After Table 3, I explain these components, which are listed in order of importance based on how many times they were mentioned during my interviews and in the literature. I also confirmed these components’ importance during my participant observation.

Using Table 3 and my explanations of these 11 components, I hope to provide guidance for my six study sites and to provide somewhat of a blueprint for schools to build effective garden programs. Using the column “schools that include components,” this table also suggests areas that supporting organizations may want to focus their efforts (i.e., only three out of the six schools I studied had clearly defined goals, and since this is the most important component, organizations should consider directing their attention there).

Table 3. Participant observation results for two AUS [Tuntable Creek Public School (TCPS) and Main Arm Upper Public School (MAUPS)] and four Maine [Kennebec Montessori School (KMS), Albert S. Hall School (ASHS), Troy Howard Middle School (THMS), and Medomak Valley High School (MVHS)] school garden programs, ranked by the number of effective components met (if not stated otherwise, 1=component met, 0=component not met). The components (which are explained in the text) are listed by importance and the schools are listed based on how many components they incorporate into their garden programs.

Component	School						Schools that Include Component
	THMS	MVHS	MAUPS	TCPS	ASHS	KMS	
1. Clearly Defined Goals	1	1	1	0	0	0	3.0
2. Passionate Teachers	1	1	1	0	1	0	4.0
3. Garden Coordinator	1	1	1	0	0	0	3.0
4. School Garden Team	1	1	1	1	1	0	5.0
5. Using the Garden Regularly to Teach Science, Nutrition, Sustainability, and Business (0.25 for each subject)	1	1	1	0.5	0.75	0.25	4.5
6. Outside Involvement by Community and Parents (0.5 for each)	0.5	0.5	1	1	0.5	0.5	4.0
7. Greenhouse and Winter Programming	1	1	0	0	0	0	2.0
8. Selling Garden Items as Primary Funding	1	1	0	0	0	0	2.0
9. Small Group Sizes	1	0	0	1	0	1	3.0
10. Student Ownership and Availability Outside of Class (0.5 for each)	0.5	1	0.5	1	1	0.5	4.5
11. Planned Maintenance Over Breaks	1	1	1	0	0	0	3.0
Effective Components Met at Each School	10.00	9.50	7.50	4.50	4.25	2.25	

1. Clearly Defined Goals

An effective garden program means different things to each of my study sites and interviewees, so it is important for key stakeholders to discuss and define goals for their gardens early in the planning stages. Each of the six schools I studied had goals, but Troy Howard (US) and Medomak Valley (US), the two most established programs, had the most clearly defined ones. Some schools want garden programs to help improve student nutrition, some want to teach students how food grows, while others may just want to get students outside. If a school does not set goals and have clear expectations, teachers and community members might pull the garden in different directions to the overall detriment of the program. Ryan Fahey-Dennett of the Maine School Garden Network explained to me why schools need to set goals for their garden programs and why gardens are not for all schools:

When I started here, our slogan was “a garden for every school,” but I’ve learned that that’s not necessarily what we want. What we want to do is make sure that every school garden has a purpose and that there is something it is trying to teach children through gardening. (R. Fahey-Dennett personal communication, 2015)

Goal setting is particularly important in cold-weather climates like Maine because most of the traditional gardening season occurs over summer vacation. If schools want to grow crops like tomatoes and beans, they either need to hold summer gardening sessions or have reliable groups of volunteers take care of the garden. However, if schools only want to garden during the school year, they would have to plant for the shoulder seasons (Spring and Fall). To do so, they would likely employ season extension practices like indoor grow lights and outdoor cold frames and hoop houses, which most of my study sites used (E. Libby personal communication, 2015).

2. Passionate Teachers

Aside from setting goals for garden programs, many of the people I interviewed believe an important component of effective garden programs is having teachers who are passionate about not only gardening, but also in teaching children how to do so (which all but two of the schools I studied had). From my observation, it was clear to me which teachers were passionate gardeners, and I’m sure the students could tell as well. While most of the study sites had passionate teachers in the garden, it seemed to me that some of the teachers were not too enthusiastic about their programs or did not have much

gardening experience. A school garden requires a large amount of work and without people who are passionate about it and want to see it succeed, it is likely to fall by the wayside. Therefore, if teachers are not passionate about gardening, they should not be forced to use a garden program (R. Fahey-Dennett personal communication, 2015). If uninterested teachers use the garden, many benefits of the program will likely be lost, and in the worst-case scenario, it might turn children away from gardening for the rest of their lives.

3. Garden Coordinator

Like the three most effective garden programs I studied, [Troy Howard (US), Medomak Valley (US), and Main Arm Upper (AUS)], having paid staff members often leads to effective garden programs. Some schools find that a teacher or volunteer can effectively run a program, but from my research, it is most effective to have a “coordinator” or “coach” whose job is to lead the garden program. Although teachers can also run garden programs (like at Albert S. Hall, Tuntable Creek, and Kennebec Montessori), separate coordinators could dedicate all of their time and energy to gardening. Many teachers are already over-worked, so adding the responsibility of entire garden programs often either leads to burnout or failed programs. Fahey-Dennett believes,

the biggest weakness of many of programs is that they rest on one or two people, such as a single teacher who has a passion for gardening. It's a lot of work for them, and [managing the many factors of garden programs is often too much]. We are trying to encourage [schools to hire garden coaches] and are trying to encourage schools, particularly with new gardens, to not go at it alone – to get a committee formed and to make sure you have support from your school before going ahead and trying to juggle all of this by yourself. (R. Fahey-Dennett personal communication, 2015)

A garden coordinator could plan lessons ahead of time, coordinate meetings among teachers, volunteers, and students, and could drastically improve the structure of the garden program. A coordinator could also take care of the garden during breaks—handling the watering, harvesting, and weeding—which is when many gardens fail. A representative from FARMS at the Regional School Garden Gathering believes that school garden “coaches” are a good way to fund garden coordinators. By using the model of paid sports coaches and physical education teachers, she believes that even

minimal grants or stipends for garden coaches are sufficient and could benefit a garden program immensely. School garden coaches seem like a good choice because when gardening, “kids are outside getting activity that is non-competitive and it is a great activity for nutrition, physical activity, and stewardship of the land” (E. Libby personal communication, 2015).

4. School Garden Team

Another important component for garden programs are groups of people in the school—composed of teachers, administrators, staff, students, parents, and community members—who are committed to the success of the program. Again, the three schools that contained the most effective components—Troy Howard (US), Medomak Valley (US), and Main Arm Upper (AUS)—each had school garden teams. According to Neil Lash (2015) of Medomak Valley, “What often kills programs is when the energy and vision of one teacher dies out; teachers already have so much on their plates and many feel like they cannot risk lower test scores by switching to gardening, when, in reality, gardening can improve test scores and pique students’ interest.” Having a team of committed people would make sure that gardens can exist in the long-term, and can convince others at the schools of the importance of school gardens. Additionally, having a committee is important to flush out ideas, build consensus, and trouble shoot, which raises the chances of having a successful program (E. Libby personal communication, 2015; J. Thurston personal communication, 2015; N. Lash personal communication, 2015).

5. Using the Garden Regularly to Teach Science, Nutrition, Sustainability, and Business

The three most effective garden programs I studied [Troy Howard (US), Medomak Valley (US), and Main Arm Upper (AUS)] used their gardens to teach a broad range of subjects including science, nutrition, and sustainability. Those three schools also have entrepreneurial aspects to their programs, including selling garden products to parents and community members, selling produce at local food stores, and selling seeds around the world. Additionally, I found that treating the garden as a normal weekly special is crucial for both student and teacher buy-in; by setting up the garden program as a weekly special, many of my study sites were able to get the whole school to participate.

Another way to encourage teacher participation is by making the garden process as streamlined as possible so that visits to the garden require as little work for them as possible (C. Gall personal communication, 2014). A way to make sure that the garden is used on a regular basis is integrating it into the curricula of other classes. For instance, at Troy Howard, every teacher develops curriculum towards the garden for their classes, including in art, math, science, and history (J. Thurston personal communication, 2015). Similarly, Medomak Valley ensures that the garden is used regularly by making it the entire focus of specific science electives.

6. Parent and Community Involvement

Another key ingredient to successful garden programs is parent and community involvement. According to Danielle Fleury (2015), Northeast staff member at the US Department of Agriculture's Food and Nutrition Service, successful garden programs often require "someone in the community being invested in the garden, making sure it is maintained over weekends and over summertime." Another benefit of having parent and community involvement is being able to tap into a broad range of skill sets (i.e., carpenters, scientists, farmers, etc.). Some schools also find that by including the community, they are able to get donations, discounts, volunteers, and patrons of garden sales. Jim Newett (2014), the principle of the school that hosted the Farm to School Conference, believes it is important to both bring the community to the school, and bring students to the community for field trips. His school accepts and promotes the involvement of the community in the maintenance and functioning of the garden. He also recommended including parents and community members in committees that guide the creation and upkeep of school gardens.

7. Greenhouse and Winter Programming

Although Maine has long, snowy winters, I found that school gardening does not have to cease in the winter. Some schools use grow lights and indoor gardening lessons to continue their garden programs over the Maine winters (including Albert S. Hall and Kennebec Montessori), and many others use greenhouses or other season extension methods to continue gardening throughout the year (including Troy Howard and Medomak Valley). However, even if schools do not garden in the winter, they can still

garden up until November and can begin again in March. Furthermore, in the winter, schools can grow things in the windows, and follow other curricular ideas, of which Maine Ag in the Classroom has many (J. Thurston personal communication, 2015).

8. Selling Garden Items as Primary Funding

Many of the garden programs I studied required fairly extensive resources and funding. After the initial garden and kitchen infrastructure was put in place, the greatest expense was the garden coordinator [(and heating fuel for the greenhouses at Troy Howard (US) and Medomak Valley (US))]. Since most school budgets are already strapped for cash, most schools need to either apply for grants or raise money in other innovative ways to support garden programs. Aside from applying for grants and recruiting free labor from the community, one of the best ways to raise money (and, as mentioned earlier, to teach entrepreneurial skills) is by selling products from the garden. Fahey-Dennett (2015) of the Maine School Garden Network explained to me, “some school gardens actually are businesses that fund at least quite a bit of the program [like at Troy Howard and Medomak Valley], some programs hold plant sales and school fundraisers—there are a lot of creative ways to fund the program.” Similarly, Fleury (2015) commented, “I have seen districts become really good at fundraisers [and] actually [become] fully sustainable just with local and private individual fundraising techniques.”

The Farm to School Conference had a lot of programming about economic sustainability. Kim Finnerty (2014), a high school chemistry teacher who led a breakout session, began a garden program at her school and is “beyond persistent” in her search for funding. She goes to local big box stores to request opened and returned garden products, gets donated propane for the greenhouse from local companies, holds annual seedling sales to raise funds, requests donations from other local businesses and farmers, uses existing bus routes to avoid transportation costs for field trips, uses the local vocational school to build garden and greenhouse structures, and applies for dozens of grants. She believes that for every 20 grants she applies for, she only gets one, but she has been successful in securing five grants. She even uses students in this process so they can gain valuable grant writing experience (K. Finnerty personal communication, 2014). Christine Gall (2014), a FoodCorps member who also attended the conference, provided

other innovative ways to fundraise for garden programs. She raises money and supplies for her school garden by allowing customers in the local co-op to round their purchases up to the nearest dollar with the proceeds going to the school garden, and by displaying a “wish list” of supplies at a local hardware store so customers have the opportunity to purchase specific items for the school garden (C. Gall personal communication, 2014).

At Troy Howard, “Besides supplying fresh food for all of Belfast’s schools and regularly donating food to the local soup kitchen, the program sells produce and seeds at its own farm stand, by mail order, and at the Belfast Co-op” (Stone, 2009, p. 35).

Thurston explained to me that the school only funds his position and the oil to heat the greenhouse over the winter. Otherwise, the bundles of spinach and Swiss chard that they sell at the co-op allow them to make money over the winter, sales at the farm stand allow them to make money over the fall, and selling potted plants to teachers and parents provides another source of income. So while many other schools are strapped for cash, Thurston has a large chunk of money saved up from the garden program that he uses for field trips, sick families, and for community events, which he believes buys them goodwill in the community (J. Thurston personal communication, 2015). Through the Heirloom Seed Project, Medomak Valley makes money by selling seeds through their catalogue and through a seed CSA (Community Supported Agriculture) in which people sign up in the beginning of the year and then receive seeds throughout the season when time to plant. They also sell value-added products like cans of salve ointment (N. Lash personal communication, 2015).

9. Small Group Sizes

As in most learning settings, low student-to-teacher ratios are important for the effectiveness of school gardens. Students are often more rambunctious outside, where they are accustomed to having recess, so from an instructional and disciplinary standpoint, teachers can more easily control smaller groups of students. More importantly, however, is the increased attention each student can get in small groups. While schools like Albert S. Hall (US) struggled at times with large group sizes, schools like Kennebec Montessori (US) benefitted from only sending small groups of students out to the garden at a time.

10. Student Ownership, In and Outside of Class

Effective school gardens are not just available to students during class time – they are available during recess, over the summer, and at other break periods too. During these times, those who use the garden choose, and are not forced, to be there as they are in class. This unstructured time also allows students to explore their own interests related to gardening, which may be the most effective form of learning. Many schools also find it important to give each student his or her own area to take ownership of in the garden, which not only gives students practice in conducting independent work, but also allows them to be more involved in the garden. Students also tend to increase their effort if they are the ones to directly reap the rewards. At several of my study sites [e.g., Kennebec Montessori (US)], the students got to choose what crops they wanted to grow. At others [e.g., Albert S. Hall (US)], students were responsible for creating a blueprint for the garden structure. This way, students feel as if the garden is “theirs” (M. Dunn personal communication, 2015).

According to a guidance counselor who attended the Maine Regional School Garden Gathering and helped start the school garden at the Georgetown School—which now has a greenhouse, an outdoor garden, beehives, composting, and a pizza oven—it is important to make the garden applicable to real life and to let students guide the garden. Although she was the staff member most responsible for the garden’s formation, it is the students who are the major drivers and volunteers. In fact, many of the students who have been involved with the garden there have encouraged their families to start gardening as well. Another value of letting the students be in charge is that the students—who may be socioeconomically disadvantaged and face food insecurity—will become engaged in school and will always be able to grow their own food.

11. Planned Maintenance Over Breaks

Effective school gardens also have consistent help during the school year and over breaks to overcome the commonly cited challenge of maintenance over breaks. Whether it is paid garden coordinators, parent volunteers, groups of students, or community members, garden programs need to be maintained over breaks to succeed, and this should not fall on just one person. Although the Troy Howard (US) garden program is extremely successful, it requires an incredible amount of commitment from Jon Thurston,

who has to be on call at all hours of the day, every day of the year, and has to tend to the garden and greenhouse 365 days a year. Many school gardens die in the summer or over breaks if they do not have someone like him, but even he is starting to feel burnt out.

POLICY RECOMMENDATIONS

Based on my surveys, interviews, and participant observation, the school gardens in my study appear to improve student nutrition, which could lead to decreased rates of obesity (Carlsson & Williams, 2008; Cotugna et al., 2012). School gardens also appear to improve students' knowledge of the environment, which could improve the way they interact with it (Hiramatsu et al., 2014; Louv, 2005). Therefore, I believe that school gardens are worthy investments for local, state, and federal governments because they are low-risk, high-reward investments for our children's health and our environment (Waters, 2008). School gardens are well represented and supported on a national level in AUS. The non-governmental Stephanie Alexander Kitchen Garden Foundation, which receives both public and private funding, seems to be able to adequately support school gardens across the country (although both of my AUS study sites had gripes about not receiving grants from the organization). The US, on the other hand, lacks a national organization with the clout and resources like AUS has. Instead, the US has a few small national organizations and hundreds of smaller ones to support school gardens. This is particularly true for Maine, which has dozens of different organizations supporting school gardens.

While smaller, local organizations are often better suited to address local needs (Love, 2014), the large number of resources and organizations could be overwhelming to teachers or school administrators who already have a lot on their plates. At the schools I studied without garden coordinators, teachers had many other responsibilities, and the garden programs often took a back seat. For schools like those, it is important that resources and assistance are as accessible as possible, which is why I recommend a national organization for school gardens similar to that of AUS. I could see two existing organizations taking this role: either the nongovernmental National Farm to School Network or the US Department of Agriculture's (USDA) Food and Nutrition Service

(FNS). Both organizations already have funding available for school gardens, but for either organization to assume a greater role, they would need more funding.

The USDA FNS farm to school program is currently funded under the federal Child Nutrition Act, which is up for reauthorization in 2015. The 2010 Child Nutrition Act Reauthorization is dubbed the Healthy, Hunger-Free Kids Act and is designed to provide students with healthy foods and to connect schools with local farmers. There are currently seven “regional office staff” across the country who are explicitly responsible for supporting farm to school activities (D. Fleury personal communication, 2015). This means that each staff member is in charge of about eight states and thousands of schools. I recommend that Congress set aside more money under the 2015 Child Nutrition Act Reauthorization to fund a farm to school staff member in each state. A staff member in each state would be better equipped to make sure that schools have the specific resources they need if they desire a school garden (W. Grenier personal communication, 2015). Without such a full-time position in each state, people who already have full-time jobs have to organize school garden efforts on top of their full-time jobs, which is unfair and often unrealistic.

Successful school gardens often become economically sustainable by selling products from the garden. However, even the two most successful programs in Maine, Troy Howard and Medomak Valley, require assistance from their schools to fund the garden coordinator positions and purchase fuel for the greenhouses. Additionally, it takes time for schools to become economically sustainable by selling products from the garden; in the beginning, there are often major expenses to create the garden infrastructure. Many schools apply for grants to fund these initial expenses, but if more and more schools create garden programs, as this thesis suggests schools do, current organizations (like Maine Ag in the Classroom, the National Farm to School Network, and the Flannel Shirt Fund) will not be able to meet their needs. This is where I recommend The Child Nutrition Act step in again.

The Child Nutrition Act requires that Congress set aside \$5 million annually to fund “competitive grant and technical assistance programs” for farm to school activities (NFSN, 2015a). This annual pool of \$5 million is split between support service grants for state or local agencies (\$65,000-\$100,000), implementation grants for schools or

school districts (\$65,000-\$100,000), and planning grants for schools or school districts (\$20,000-\$45,000) (USDA FNS, 2015). Even if they only offered the minimum grant of \$20,000, they could at most support 250 schools or school districts. Considering that there are over 98,000 public schools in the US (IES, 2015), the \$5 million is not nearly enough to support US school gardens. Part of the proposed 2015 Reauthorization, dubbed the Farm to School Act of 2015 would increase grant funding to \$15 million a year to “better meet the high demand and need for this funding” since only about a fifth of the schools that applied for funding under the 2010 Act received it (NFSN, 2015b). Tripling the available grant money will still not be enough, but it is a step in the right direction.

CONCLUSION

This thesis explored three research questions: (1) How do school gardens affect students’ nutritional habits, environmental knowledge, and sustainability practices? (2) What organizations exist in Maine to support school gardens and what are their roles? and (3) What components do successful school garden programs share? Using participant observation, interviews, and surveys in two schools in AUS and four schools in Central Maine, I conclude that school gardens (1) encourage children to become more adventurous and healthful eaters, (2) effectively teach environmental science lessons in an out-of-classroom setting, and (3) instill environmentally sustainable practices into students that will potentially follow them into adulthood. Unlike in AUS, where the national Stephanie Alexander Kitchen Garden Foundation is the primary organization supporting school gardens, in the US, and particularly in Maine, there are several smaller organizations—like the Maine School Garden Network and FoodCorps—to support school gardens. Furthermore, I found 11 factors that appear to contribute to effective school garden programs: clearly defined goals; passionate teachers; dedicated coordinators; overseeing teams; regularly teaching nutrition, sustainability, environmental science, and business skills; parent and community involvement; programming over the winter; selling garden items to fundraise; small group sizes; student leadership; and planned maintenance over breaks.

My results confirm those of previous studies that find positive associations between school garden participation and (1) proper nutrition, (2) enhanced environmental

knowledge, and (3) increased desires to live sustainably. My findings further provide specific recommendations to organizations supporting school gardens, schools wishing to start or improve school gardens, and policymakers. Several limitations should be considered when interpreting these findings, including my inability to look at changes in students over time, small sample sizes, and fairly short study periods. Furthermore, although I believe the regions I studied were ideal due to their rural nature and their vibrant local foods movement, it is unclear how my results would transfer to urban settings. Future studies on school gardens—particularly in understudied regions like Central Maine and on understudied topics like environmental sustainability—are needed to confirm my findings. Researchers should also consider the following questions: how effective are school gardens compared with other farm to school programs like farm field trips? What are the major barriers to starting or maintaining school gardens? How can schools keep their programs financially viable and their resources sustainable? In what ways can school gardens interact with broader educational and curricular goals? Can school gardens in urban areas be run like those in rural areas and are they as effective?

REFERENCES

- Alexander, S. (2010). *Stephanie Alexander's Kitchen Garden Companion* (International Edition ed.): Penguin Australia.
- Blair, D. (2009). The Child in the Garden: An Evaluative Review of the Benefits of School Gardening. *Winter*, 40(2), 15-38.
- Block, K., Gibbs, L., Staiger, P., Gold, L., Johnson, B., Macfarlane, S., . . . Townsend, M. (2011). Growing Community: The Impact of the Stephanie Alexander Kitchen Garden Program on the Social and Learning Environment in Primary Schools. *Health Education & Behavior*, 39(4), 419-432.
- CAFS. (2014). State Farm to School Legislative Survey: 2002-2013. Vermont Law School Center for Agriculture and Food Systems: from: http://www.farmentoschool.org/Resources/State_Farm_to_School_Legislative_Survey_4_2014.pdf.
- Calder, A. (2014). *Onion-theft story has sweet ending for Waterville Students*. Portland Press Herald: from <http://www.pressherald.com/2014/09/11/onion-theft-story-has-a-sweet-ending/>.
- Carlsson, L., & Williams, P. L. (2008). New approaches to the health promoting school: Participation in sustainable food systems. *Journal of Hunger and Environmental Nutrition*, 3(4), 400-417.
- Cotugna, N., Manning, C., & Didomenico, J. (2012). Impact of the Use of Produce Grown in an Elementary School Garden on Consumption of Vegetables at School Lunch. *Journal of Hunger & Environmental Nutrition*, 7(11-19).
- Diebel, M. (2014). It's a crying shame: Thief steals 5th-graders' onions. *USA Today*.
- Dollard, S. A. A. (2012). *Stephanie Alexander Kitchen Garden Cooking with Kids*. Melbourne, Australia: Penguin Group.
- Durakoglu, A. (2014). Environmental education in the context of child's interaction with nature according to Maria Montessori. *Anthropologist*, 18(2), 309-313.
- ESRI. (2011). ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
- FARMS. (2015). *Our Mission*. Focus on Agriculture in Rural Maine Schools: from <http://www.mefarms.org/about/our-mission/>.
- FoodCorps. (2013). FoodCorps: Connecting kids to real food and helping them grow up healthy.

- Gibbs, L., Staiger, P., Townsend, M., Macfarlane, S., Gold, L., Block, K., . . . Waters, E. (2013). Methodology for the evaluation of the Stephanie Alexander Kitchen Garden program. *Health Promotion Journal of Australia*, 24, 32-43.
- Gibbs, L., Staiger, P. K., Johnson, B., Block, K., Macfarlane, S., Gold, L., . . . Ukoumunne, O. (2013). Expanding Children's Food Experiences: The Impact of a School-Based Kitchen Garden Program. *Journal of Nutrition Education and Behavior*, 45(2), 137-146.
- Graham, H., Beall, D. L., Lussier, M., McLaughlin, P., & Zidenberg-Cherr, S. (2005). Use of school gardens in academic instruction. *Journal of Nutrition Education and Behavior*, 37(3), 147-151.
- Green, M., & Duhn, I. (2015). The Force of Gardening: Investigating Children's Learning in a Food Garden. *Australian Journal of Environmental Education*.
- Guest, G., Namey, E., & Mitchell, M. (2013). *Collecting Qualitative Data: a field manual for applied research*: Sage Publications, Inc.
- Guitart, D. A., Pickering, C. M., & Byrne, J. A. (2014). Color me healthy: Food diversity in school community gardens in two rapidly urbanising Australian cities. *Health & Place*, 26, 110-117.
- Hazzard, E. L., Moreno, E., Beall, D. L., & Zidenberg-Cherr, S. (2011). Best Practices Models for Implementing, Sustaining, and Using Instructional School Gardens in California. *Journal of Nutrition Education and Behavior*, 43(5), 409-413.
- Helicon. (2014a). New South Wales *The Hutchinson Unabridged Encyclopedia with Atlas and Weather Guide*.
- Helicon. (2014b). Maine *The Hutchinson Unabridged Encyclopedia with Atlas and Weather Guide*.
- Henryks, J. (2011). Changing the menu: rediscovering ingredients for a successful volunteer experience in school kitchen gardens. *Local Environment*, 16(6), 569-583.
- Hiramatsu, A., Kurisu, K., Nakamura, H., Teraki, S., & Hanaki, K. (2014). Spillover Effect on Families Derived from Environmental Education for Children. *Low Carbon Economy*, 5, 40-50.
- Hunziker, E. (2014). Raised 'em myself in my U.S. School Garden. *World War I Poster Project at Gettysburg College*, from <http://cupola.gettysburg.edu/wwiposters/5/>.
- IES. (2015). *National Center for Educational Statistics*. Institute of Educational Sciences: from <https://nces.ed.gov/fastfacts/display.asp?id=84>.

- Kangas, M., Vesterinen, O., Lipponen, L., Kopisto, K., Salo, L., & Krokfors, L. (2014). Students' agency in an out-of-classroom setting: Acting accountably in a gardening project. *Learning, Culture and Social Interaction*, 3(1), 34-42. doi: <http://dx.doi.org/10.1016/j.lcsi.2013.12.001>
- Louv, R. (2005). *Last Child in the Woods: Saving our Children from Nature Deficit Disorder*. North Carolina: Algonquin Books of Chapel Hill.
- Love, E. (2014). *The Relationships between Local Food and Food Security in Maine*. Honors Theses Paper 732: from <http://digitalcommons.colby.edu/honorstheses/732>.
- Maine Department of Education. (2014). % Free and Reduced School Lunch Report. from https://portal.maine.gov/sfsr/sfsrdev.ed534.ed534_parameters
- Maine Initiatives. (2012). The Flannel Shirt Fund. from: <http://maineinitiatives.org/Grants/FlannelShirtFund/tabid/103/Default.aspx>.
- MAITC. (2014). *About Us*. Maine Agriculture in the Classroom: from <http://agclassroom.org/me/about/index.htm>.
- MassAITC. (2011). *Directory of Massachusetts Schools with School Garden Programs*. Massachusetts Agriculture in the Classroom: from http://www.aginclassroom.org/School_Gardens/School-Gardening_Directories/Schools_Directory.pdf?key=0At9-x9PLhtL8dE5iUThmcjJDcGdnTjFGGe9zRlpNM2c&single=true&gid=1&output=pdf.
- MAUPS. (2014). Main Arm Upper Public School: from <http://mainarmpublicschool.com.au>.
- McAleese, J., & Rankin, L. (2007). Garden-Based Nutrition Education Affects Fruit and Vegetable Consumption in Sixth-Grade Adolescents. *Journal of the American Dietetic Association*, 107(4), 662-665.
- Meltzer, J. (2014). School Kitchen Gardens: Cultivating a Child's Nutritional Habits, Environmental Knowledge, and Sustainability Practices. *SIT Study Abroad*.
- MOFGA. (2014). *Maine Harvest Lunch / Farm to School*. Maine Organic Farmers and Gardeners Association: from <http://mofga.org/Resources/MaineHarvestLunch/tabid/817/Default.aspx>.
- Montessori, M. (1948). *To Educate the Human Potential*. India: Kalakshetra Publications.
- Morgan, P., Warren, J., Lubans, D., K.Saunders, Quick, G., & Collins, C. (2010). The impact of nutrition education with and without a school garden on knowledge,

- vegetable intake and preferences and quality of school life among primary-school students. *Public Health Nutrition*, 13(11), 1931-1940.
- Morris, J., & Zidenberg-Cherr, S. (2002). Garden-Enhanced Nutrition Curriculum Improved Fourth-Grade School Children's Knowledge of Nutrition and Preferences for Some Vegetables. *Journal of the American Dietetic Association*, 102(1), 91-93.
- MSGN. (2015). *Maine School Garden Network: Supporting and promoting educational gardens across Maine*.
- MVHS. (2015). *MVHS Heirloom Seed Project*. Medomak Valley High School: from <https://sites.google.com/a/msad40.org/mvhs-heirloom-seed-catalog/>.
- MyRegion. (2014). Northern Rivers. from <http://myregion.gov.au/profile/northern-rivers-about>
- NFSN. (2012). *What is farm to school?* National Farm to School Network.
- NFSN. (2015a). Farm to School Advocacy. National Farm to School Network: from: <http://www.farmtoschool.org/policy>.
- NFSN. (2015b). Farm to School Act of 2015. National Farm to School Network: from: [http://www.farmtoschool.org/Resources/2014 CNR F2S handout v8 for grassroots and web.pdf](http://www.farmtoschool.org/Resources/2014%20CNR%20F2S%20handout%20v8%20for%20grassroots%20and%20web.pdf).
- Nicholson, L., Turner, L., Schneider, L., Chriqui, J., & Chaloupka, F. (2014). State farm-to-school laws influence the availability of fruits and vegetables in school lunches at US public elementary schools. *Journal of School Health*, 84(5), 310-316.
- NSWGDP. (2006). *Far North Coast Regional Strategy*. NSW Government Department of Planning.
- Obama, M. (2012). *American Grown: The Story of the White House Kitchen Garden and Gardens Across America*. New York: Crown Publishers.
- Orr, D. (2004). *Earth in Mind: On Education, Environment and the Human Prospect* (10th Anniversary ed.). Washington: Island Press.
- Parmer, S. M., Salisbury-Glennon, J., Shannon, D., & Struempfer, B. (2009). School Gardens: An Experiential Learning Approach for a Nutrition Education Program to Increase Fruit and Vegetable Knowledge, Preference, and Consumption among Second-grade Students. *Journal of Nutrition Education and Behavior*, 41(3), 212-217.
- Passy, R., Morris, M., & Reed, F. (2010). Impact of School Gardening on Learning. *National Foundation for Educational Research*.

- Ramírez, R. (2013). Pass the Change, Please: Stymieing America's Childhood Health Crisis with Local Foods in Schools. *Duke Forum for Law & Social Change*, 5, 129-147.
- Royal Horticultural Society. (2007). Gardening in Schools: A Vital Tool for Children's Learning.
- SAKGF. (2012). *The Stephanie Alexander Kitchen Garden Program: Implementation Manual, Third Edition*. Stephanie Alexander Kitchen Garden Foundation.
- SAKGF. (2015). *Kitchen Garden Schools*. Stephanie Alexander Kitchen Garden Foundation: from <http://www.kitchengardenfoundation.org.au/about-us/the-program/kitchen-garden-schools>.
- Shiva, V. (2008). *Soil Not Oil: Environmental Justice in a Time of Climate Crisis*. Brooklyn, New York: South End Press.
- Skelly, S. M., & Bradley, J. C. (2007). The growing phenomenon of school gardens: Measuring their variation and their affect on students' sense of responsibility and attitudes toward science and the environment. *Applied Environmental Education and Communication*, 6(1), 97-104.
- SNR. (2013). *Sustain Food Roadmap*. Sustain Food Working Group, Lismore: Sustain Northern Rivers.
- StataCorp. (2013). Stata Statistical Software: Release 13. College Station, TX: StataCorp LP.
- Stone, M. (2009). *Smart by Nature: Schooling for Sustainability*. California: Watershed Media.
- TCPS. (2014). Tuntable Creek Public School: from <http://www.tuntableck-p.schools.nsw.edu.au>.
- TeachME. (2014). Teach ME About Food and Farms: from <http://teachmefoodandfarms.org>.
- THMS. (2015). *The THMS Garden Project*. Troy Howard Middle School: from <http://www.schoolgardenproject.com>.
- Thompson, O. M., Ghelardini, L., Keene, K. L., & Stewart, K. B. (2014). Farm-to-school programmes in the USA: An examination of state-level enacted, pending and vetoed or dead bills. *Health Education Journal*, 73(4), 394-402.

- Trelstad, B. (1997). Little Machines in Their Gardens: A History of School Gardens in America, 1891 to 1920. *Landscape Journal*, 16(2), 161.
- Turner, L., & Chaloupka, F. J. (2012). Slow Progress in Changing the School Food Environment: Nationally Representative Results from Public and Private Elementary Schools. *Journal of the Academy of Nutrition and Dietetics*, 112(9), 1380-1389.
- USCB. (2013). *State & County QuickFacts*. United States Census Bureau: from <http://quickfacts.census.gov/qfd/states/23/2380740.html>.
- USDA FNS. (2015). *Farm to School Grant Program*. United States Department of Agriculture Food and Nutrition Service: from <http://www.fns.usda.gov/farmentoschool/farm-school-grant-program>.
- Waters, A. (2008). *Edible Schoolyard: A Universal Idea*. San Francisco: Chronicle Books.
- Williams, D. R., & Dixon, P. S. (2013). Impact of Garden-Based Learning on Academic Outcomes in Schools: Synthesis of Research Between 1990 and 2010. *Review of Educational Research*, 83(2), 211-235.

Personal Communications

- A. Bath, personal communication. (2014). Principal Teacher at the Tuntable Creek Public School.
- A. Vallance, personal communication. (2014). *Program Research and Development Manager at the Stephanie Alexander Kitchen Garden Foundation*.
- C. Curran, personal communication. (2014). Kitchen Garden Coordinator at Main Arm Upper Primary School.
- C. Gall, personal communication. (2014). FoodCorps Maine Service Member.
- C. Tranberg, personal communication. (2014). Teacher at Main Arm Upper Primary School.
- D. Fleury, personal communication. (2015). Northeast staff member at the USDA Food and Nutrition Service's farm to school program.
- E. Libby, personal communication. (2015). Extension educator, state supervisor for FoodCorps Maine, and state co-lead for National Farm to School Network.
- J. Newett, personal communication. (2014). Ellsworth Middle School Teacher.
- J. Piotti, personal communication. (2014). President and CEO of Maine Farmland Trust.

- J. Thurston, personal communication. (2015). Education technician at the Troy Howard Middle School.
- K. Finnerty, personal communication. (2014). Auburn High School's School Garden Lead and Science Teacher.
- L. Butera, personal communication. (2015). Elementary Teacher at the Kennebec Montessori School.
- M. Dunn, personal communication. (2015). Fifth grade teacher at the Albert S. Hall School.
- N. Lash, personal communication. (2015). Horticulture teacher at Medomak Valley High School.
- P. Cuming, personal communication (2014). [Managing Director, Sustainable Futures Australia. Personal Communication via Skype and Email, 20th February 2014].
- R. Fahey-Dennett, personal communication. (2015). Coordinator of the Maine School Garden Network.
- W. Grenier, personal communication. (2015). Director of Maine Ag in the Classroom.

APPENDICES

Appendix I: Interview Questions

1. Please give me a brief description of the history of the garden program at your school/in your organization/your state/your region
2. Why are you involved with it/how did you first start?
3. What does sustainability mean to you and how does the garden fit into that?
4. What are the major strengths of the program? Do the students seem to enjoy it? Are there any family impacts you are aware of?
5. What are the major weaknesses of the program?
6. What influence do you think the program has on students' eating habits?
7. How do you think your students' grasp on the environment, its natural processes, and environmental challenges have changed due to the program?
8. How do you think your students act/will act more/less sustainably in the future because of this program?
9. Can you describe the components of an effective school garden program?
10. What is your vision for the program over the next 2-3 years? (if funding were not an issue/if you had full community and school support/(what are other constraints)?)
11. What are some of the best ways to fund the program, either with or without school funding? (For example, private businesses, state government, grants...)
12. Do you think there should be policies on the local/state/national level requiring school gardens? If so, how should it look, how should it be run, should there be curricula?
13. What is the role of learning standards in the garden program?

Appendix II: Study Briefing, Student Survey, and Consent Form

Explanation of Study for Parents and Students

Please keep this sheet for future reference

“School Gardens: Cultivating a Child’s Nutritional Habits, Environmental Knowledge, and Sustainability Practices”

By Jeff Meltzer, Colby College

Fall 2014

Introduction and Background/Purpose: I am a senior Environmental Policy Major from Colby College. I am undertaking this study as a part of my senior honors thesis. My primary study question is “how do school gardens contribute to elementary school students’ nutritional habits, environmental knowledge, and practices of sustainability?” My second study question is “in what ways can school gardens be effective and economically self-sufficient?” I will study the gardens at both The Kennebec Montessori and Albert Hall Schools and see how the program affects students, specifically with regards to sustainability.

I would appreciate if parents and students could take the time to fill out the attached consent form and for students to fill out the attached survey. Before students and parents agree to participate in this study, they should know enough about it to make an informed decision. If you have any questions or concerns, or if you would like to see my approved Colby IRB proposal, I can be reached by email (jmeltzer@colby.edu) or mobile phone (978-868-0146).

Information: Participation in this study will involve some, if not all, of the following:

- A survey for students (about 10 minutes)
- Observation of the garden program during school hours

The information gained from all surveys and observations will be incorporated into a written report as a requirement for my senior honors thesis and will likely be deposited in the Colby library where it will be available for hard copy and electronic public review. It will also form part of several oral presentations at Colby. Additionally, the study will be shared with the schools I am studying and other relevant organizations in the U.S.

Risks: There no foreseeable risks involved in this study (see “Confidentiality” below).

Benefits: The direct benefit for participants is a chance to reflect upon their experiences with the gardens. Additionally, the final report will be circulated among the study schools, which will give the schools a chance to improve their programs based on the suggestions and comments of the participants’ surveys and interviews, and it will go to other organizations to assist in improving their programs.

Confidentiality: As stated in my approved Colby IRB application, all children will remain anonymous; their names will not be mentioned in my report or shared in any other way.

Participation: Students’ participation in this study is voluntary; they (or their guardians) may decline to participate. If they decide to participate, they may withdraw from the study at any time. They may also decline to answer any specific question. If they withdraw from the study at any time the information already obtained from them will be destroyed.

School Garden Survey for Students – Complete As Best As You Can
Please Return to School by November 3rd (Only complete after signing opposite side)

1. What do the words “environment” and “sustainability” mean to you?

Environment: _____

Sustainability: _____

2. How much do you like your school garden (circle one)?

1) Really like it 2) Like it 3) Don't love it or hate it 4) Don't like it 5) Really dislike it

3. What do you like most about your school garden?

4. How often do you usually eat fresh fruits and veggies (circle one)?

1) More than once a day 2) Almost every day 3) Several times a week 4) Once a week

5. Circle everything you think you are good at:

1) Growing food in a garden 2) Identifying seasonal changes 3) Preparing food
4) Identifying fruits and veggies 5) Working with other students 6) Protecting the earth

6. If you could change three things about the school garden what would they be?

a. _____
b. _____
c. _____

7. Do you know what any of the following terms mean (circle all that you know)?

1) Water conservation 2) Fertilizer 3) Climate change 4) Processed foods 5) Permaculture
6) Local food 7) Organic 8) Whole foods 9) Food deserts 10) Pesticides

8. If you had to make a home-cooked dinner for yourself, your friends, and your family, what would you make and where would you get the ingredients (be specific if you can)?

9. Circle each of the following things you want to do when you grow up:

1) Plant a garden 2) Care for the environment 3) Recycle 4) Shop at a farmers' market
5) Buy organic food 6) Eat fast food regularly 7) Compost 8) Eat fruits and veggies regularly

10. I am a ____ year-old grade ____ boy / girl in Mr. / Mrs. _____ class at the _____ School, and have been involved with the school garden since grade ____.

Guardian Consent (see “Explanation of Study” sheet):

I have discussed the research project with my child, they have agreed to participate, and I, _____, allow my child _____, to participate in the school garden survey process. All students’ names will be kept anonymous in the final report, and human subjects review standards will be followed.

Signed: _____ Date: _____

Researcher’s Signature (leave blank): _____ Date: _____

Student Consent:

Sign or write your name here if your parent/guardian has discussed the study with you and explained any risks or benefits:

Signed: _____ Date: _____

Researcher’s Signature (leave blank): _____ Date: _____