


Spring 5-2016

A NEW VISION FOR AN OLD INSTITUTION: ADDRESSING THE CHALLENGES FOR URBAN AND PERI- URBAN AGRICULTURE AT THE WALTHAM EXPERIMENT STATION

Kevin C. Hartzell

University of Massachusetts - Amherst, khartzel@larp.umass.edu

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ADDRESSING THE CHALLENGES FOR URBAN AND PERI-URBAN AGRICULTURE AT THE
WALTHAM EXPERIMENT STATION

Department of Landscape Architecture and Regional Planning
University of Massachusetts Amherst
Masters of Landscape Architecture Design Project
Kevin C. Hartzell
May 2016

Approved By:

Jack Ahern, Ph.D., FASLA Committee Chair

Frank Slegers, Committee Member

Elisabeth Hamin, Ph.D., Department Head

ACKNOWLEDGEMENTS

This project has been a labor of love and hate. It began in 2008 when Jack Ahern, PhD., FASLA asked me to help develop a study and proposal for the Waltham Experiment Station. During this process, it became clear to me that a real opportunity existed for UMASS Extension to become involved in the renaissance of growing food in cities and local agriculture production commonly referred to as urban agriculture. I would like to extend my gratitude to; Jack Ahern for his leadership and review and critique of my work and serving as chairperson and Frank Slegers as committee member- without their guidance and encouragement, this project would have never come to fruition.

I would also like to thank the excellent and encouraging faculty and staff in the Landscape Architecture and Regional Planning Department who have helped me see this project through; Mike Davidsohn, Mark Lindhult, Mark Hamin, Terry Trudeau, and Marny West. I am grateful to many others at UMASS Amherst, and Extension who have helped guide this project along.

Howard and Marykay Hartzell, whose weekly inquiry into my progress helped keep the end of this project and degree in my sights- thank you for your support.

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Abstract

Urban and peri-urban agriculture has a new place in (sub)urban landscapes because of the suite of ecosystem services it can provide including, but not limited to; increased local food production, waste recycling, stormwater infiltration, and reconnecting urban dwellers to their food source. The University of Massachusetts Amherst's Waltham Experiment Station, located in Waltham, Massachusetts, is poised for redevelopment as a model for multi-use urban agriculture production, research, and education as well as a living laboratory to monitor and document the ecosystem services provided to the surrounding community. This project will focus on educational and research categories within the theme of cultural ecosystem services and how this new vision for extension can strengthen urban and peri-urban agriculture activities.

1 INTRODUCTION

a. A New Food Agenda

Across the globe people are reconnecting with the food they consume. National Geographic Magazine produced an 8 part series called The Future of Food (2014); 'How to Feed Our Growing Planet', which addresses current and future challenges of production and access to healthy and nutritious food in a more populated world. School programs like "Added Value" in Brooklyn, New York employ students to raise vegetables in vacant urban land - growing, selling, donating and marketing produce to restaurants, soup kitchens and food pantries (Cardwell, 2003). Vacant brownfield land in rust belt cities like Detroit, Cleveland, and Milwaukee once known for industrial production is being converted to produce food (Grewal & Grewal; 2010; Imbert, 2010; Hodgson, et. al, 2011). Seattle's P-Patch Program, Growing Power in Milwaukee, Five Borough Farm in New York City and countless other "food-centric" organizations are utilizing land in vacant and underused greenspaces in the United States.

The United Nations (UN), World Bank, and Food and Agriculture Organization (FAO) are working to promote a new food agenda throughout the Middle East, Asia, Africa, Latin America and Europe by developing alternative agriculture models that address food insecurity, urbanization, and environmental justice. These institutions are helped by non-profit and non-governmental aid agencies like the International Development Research Center (IDRC) and Resource Centres on Urban Agriculture and Food Security Foundation (RUAF) that among many programs, contributes to the sustainable development of food, environment, and urbanization through research and outreach, knowledge generation and technical assistance, policy development and planning for urban food systems (Mougeot, 2006; RUAF, 2015). Cities in developing nations from Latin America, East Africa, and Asia that are experiencing high rates of poverty concentration in urban areas, environmental degradation, and lack of employment have turned to growing food in cities to alleviate the challenges of urbanization even against surmountable policy, structural, and economic challenges for doing so (De Zeeuw, et.al, 2010; Zezza & Tasciotti, 2010; Smith, 2010; Veenhuizen, 2006)

In the United States, federal agencies like The United States Department of Agriculture (USDA) is engaged in researching consumer trends for locally produced foods and the social and economic benefits of a local system versus the current model of industrial agriculture production and global distribution (See Martinez, 2010 for a full report and definition of Local Food Systems in the United States). The USDA report authored by Martinez et. al., (2010) found that locally produced food is more likely to occur on small farms located in or near metropolitan areas and local food markets account for a small but growing share of total U.S. agricultural sales;

- Direct to consumer sales increased to 1.2 billion in 2007, up from 551 million in 1997
- Farmer's markets rose to 5,274 in 2009, up from 1,755 in 1994
- Community Supported Agriculture (CSA) organizations in 2010 exceeded 1,400 (number could be larger) up from 2 in 1986 and 400 in 2001.
- Farm-to-school programs (schools that source food products from local farms) increased to 2,095 in 2009, up from 2 in the 1996-97 school year and 400 in 2004. Additionally 16% of schools have guidelines for purchasing local produce.

The Environmental Protection Agency (EPA) is also engaged in local food trends connecting food production in and around cities as a way to promote environmental justice by using green spaces for food production to address stormwater runoff, urban water pollution, land revitalization, and improper waste disposal (EPA 2010).

The American Planning Association (APA), municipal and regional planning offices, countless local and national non-profit civic minded organizations, private planning and design firms, and local residents are engaged in the trends for local food production and consumption to address the complex challenges of urbanization and food insecurity. The American Planning Association (APA) (Hodgson et.al., 2011) is encouraging comprehensive plans and zoning ordinances to allow for a variety of agriculture production forms and intensities. Open spaces, vacant land, and school yards from the outskirts of cities to residential suburban and inner-city neighborhoods, and abandoned industrial site are being reimagined as land for local, if not urban food production and food waste cycling.

The design and planning of new parks and civic open spaces over the last decades have increasingly included a spatial strategy and programming for agriculture production and learning such as; Shelby Farms Park Master Plan (Field Operations, 2008) Viet Village Urban Farm (Mossup +Michaels, 2007), Lafayette Gardens Detroit (Kenneth Weikal Landscape Architecture, 2012). The Shelby Farms Park in Memphis not only provides for agriculture production, but includes programming for education and research that can help overcome the barriers for a local food production system. The Berger Partnership (2011) used Seattle neighborhoods as a case study to investigate the potential economic, social, and environmental benefits and barriers associated with local food production in order to better understand how agriculture production can best be integrated into planning and design projects in urban areas.

Imbert (2010), in her essay *Aux Fermes Citoyens* writes that there are two main trends in the call for sustainable agriculture in the United States. The first from the top of the social spectrum, highly publicized and high profile advocates such as authors of food and cooking publications to the removal of lawn and installation of a vegetable garden at the White House (Imbert 2010; Reynolds, 2011) promoting healthy eating through the production of fresh foods consumed locally that is environmentally conscious while strengthening a local economy. The other end of the spectrum can be categorized as the grassroots movements like Milwaukee's Growing Power or Detroit's Urban Farming whose goals or mission is often beyond food production and consumption, but to also transform the social fabric of the neighborhood (Imbert, 2010). These grassroots efforts often target activating abandoned or vacant land and providing social connections for inner-city or immigrant populations.

Concern for, and interest in productive landscapes within and around cities across the globe has (re) emerged as a central idea for meeting the diverse needs of urban dwellers. Food has emerged as an important topic for three broad but complex reasons: (1) the world is experiencing unprecedented total population (+ 7 billion), (2) global urbanization which has led to (3) the increasing reliance on industrial agriculture to provide food for most of the world- which it arguably fails to do in an equitable way.

Urban Agriculture (UA) has emerged as a new paradigm with historic antecedents for combatting these complex and interrelated contemporary issues of urbanization, environmental degradation, and food production and access. Urban agriculture has equally become a symbol for the groundswell of social, environmental, and political support for a local food system that addresses the shortcomings of the current model of industrial agriculture production, global distribution, and unequitable access. Across the globe, broad claims are made for the benefits of urban agriculture that can address inter-related social and environmental challenges such as; access to healthy and nutritious food, promoting sense of community through gardening, providing recreational opportunities, reducing

energy use for food production and transport, preserving or enhancing urban ecology and green spaces, providing space for nutrient cycling of food wastes are widely cited (Napawan, 2014; De Zeeuw, 2011; Viljoen et. al., 2005; Smit & Nasr, 1996). Though some of the economic benefits of local or urban agriculture in the United States were addressed by the USDA (Martinez, 2010), the potential economic benefits provided by urban agriculture in developing countries are unclear considering the variety of production methods, scope and scale of UA, goals of individual projects, the people involved in urban agriculture, and widely varying levels of organization and investment (Zeza & Tasciotti 2010).

These broad claims for the benefits of UA are important for the continuing dialogue on sustainable cities, urban and regional greenspaces, public health, and urban ecology (De Zeeuw, et.al., 2011; Zeza & Tasciotti, 2010; Viljoen, 2005; Sandhu, 2013) but has also created many challenges for research and implementation of urban agriculture (Napawan, 2014; Reynolds & Cohen, 2014; Reynolds, 2011). In both arena's, research and practice, UA is often undefined, unrealistic, and unrelated to the urban fabric for which it seeks to benefit (Napawan, 2014). Additionally, this lack of definition and understanding in both research and practice lends itself to real challenges for implementation of UA like land use and building policies that support urban agriculture, access to land and land tenure, resource and technical needs, understanding the human and ecosystem benefits, and developing local markets for economic viability (Napawan, 2014; Reynolds & Cohen, 2014; Reynolds, 2011; Golden, 2013; Hendrickson & Porth, 2012).



Urban Agriculture in Havana Source: Inhabitat.org

This project seeks to address some of the challenges and barriers for bolstering an urban agriculture system through the reinvestment and redesign of the University of Massachusetts Amherst (UMA) Waltham Experiment Station located in the Boston metropolitan city of Waltham, Massachusetts. Drawing on some of the challenges identified in the literature on Urban Agriculture across the globe, this former extension office can be renewed to be a center for urban agriculture research to address the gaps in research and the resource needs for urban agriculture to be a viable and integrated urban infrastructure system. While UA continues to be a broad topic of discourse for the study of cities and urban design, this project will use the study of ecosystem services, and more specifically cultural ecosystem services as a framework for evaluating the benefits that urban agriculture research and outreach can provide to urban settings. The cultural ecosystem services framework will provide a narrow scope for focused research, definition development, and a literature review on typologies of and challenges for urban agriculture.

b. Trends in Urban Agriculture/ “State of the Art”

Growing food in and around cities has been a part of urban living dating back to food and water networks of the ancient Maya settlements (1000 BC) and Mediterranean cities like Constantinople (Barthel & Isenhdahl, 2012). In the United States and many western nations, modernity, progress and innovation associated with urban life in the 1900's marked the beginning for local agriculture as obsolete in efficient and modern cities (Barthel & Isenhdahl, 2012). Amidst a new environmental and social literacy about the current global and industrial food system that relies heavily on energy inputs to produce and transport food, generates vast amounts of processed foods and waste, and equally

creates barriers for access to healthy and nutritious food; growing food in and around cities has experienced a renaissance beginning over the last several decades (Grewal & Grewal, 2010; Viljoen et al., 2005; Smit & Nasr, 1996). These contemporary issues surrounding food production and access and environmental degradation and poverty as a result of urbanization are complex and interrelated subjects.

The statistics surrounding population growth and the effects of urbanization are widely reported;

- total population of 9 billion by 2050
- 60% of the population living in cities by 2030
- Urbanization in cities in developing countries is synonymous with slums- 40% of urban population living in slums by 2020 (UNFPA, 2007; UN-HABITAT, 2007; De Zeeuw, 2010; Mougeot, 2006)

The United Nations Millennium Development Goals (MDG) provide an international framework for measuring progress in human development in light of these statistics. Research and practice of UA suggests that growing food in and around cities can contribute to 3 of the 8 goals. Though each of the MDG are important indices for human progress, the three most relevant to UA are below;

- Goal 1- Eradicate extreme poverty and hunger
- Goal 3- Promote gender equality and empower women
- Goal 7- Ensure Environmental Sustainability

According to the United Nations Development Program (UNDP), urban agriculture has the potential to bring productive uses back to urban lands while providing jobs, social capital, and activating green spaces (Smit et al. 1996). The trends for and application of UA in this context directly relates to the pivotal work by Smit et. al (1996) and the UNDP. The UNDP report (1996) presented a “thumbnail sketch” (Zezza, Tasciotti 2010 p.2) that up to 800 million people globally are engaged in urban agriculture activities employing up to 200 million urban dwellers who sell goods to market while De Zeeuw et.al. (2010) found that the proportion of residents involved in UA varies but is substantial (13% in Accra, 15%-20% in Dar es Salaam, 20% in Lima). Zezza & Tasciotti (2010) citing a study by Ruel et.al (1998) that 40% of urban dwellers in Africa and 50% in Latin America are engaged in some form of urban agriculture, but contest that these estimates may not be accurate. Zezza & Tasciotti (2010) conclude that urban agriculture in developing is not a negligible component of the urban economy involving between 10% and 70% of urban households and while providing greater caloric variety vulnerable urban poor populations, the results of their study indicate that the economic impacts of UA at the household level is small and more quantitative research is needed.

b1. Social Issues

The research by Zezza and Tasciotti (2010) attempt to address the potential economic benefits provided by urban agriculture and directly acknowledge the dearth of quantitative research. This sentiment is echoed throughout much of the emerging research on the realized benefits of UA for those in need. Much of the literature on UA addresses the broad environmental and social justice benefits of growing food in cities and includes many disciplines including public health, community development, agriculture science and agronomy, and the social sciences (Napawan, 2014). The potential social justice benefits of UA range from food insecurity issues to the benefits of community building, social capital and addressing racial and cultural inclusivity in food access. Food insecurity is the lack of financial resources, rising food costs, and the lack of healthy sources for calories that cause hunger and malnourishment. The Rome Declaration on Food Security (FAO, 1996 in Flora 2010) found that the cause(s) of food insecurity are more than inadequate food production, but also that poverty, and poverty related to lack of human rights are also factors. Food insecurity is increasingly affecting dense poverty stricken slums in developing countries where residents spend up to 85% of

their income on food and US city households expenditures range 10- 40% (Sonnino 2009) and lack basic access to fresh nutritious food. Flora (2010) writes, that at the time of the Rome Declaration by the FAO it was quickly realized that industrial agriculture alone was not the solution to food insecurity, but that structural issues and local empowerment for sustainable agriculture was needed. Despite unprecedented agriculture production from the industrial model, it is estimated that more than 1 billion people are undernourished worldwide (Sandhu et. al., 2013)

Urban agriculture is also a way to provide multi-dimensional social and educational goals beyond growing food by building community, providing educational experiences and skill development, and opportunities for activating or creating green spaces across cultures and generations (Surls et.al., 2014; Reynolds & Cohen 2014). Barthel et.al. (2012) frame UA in the context of resilience noting that urban food production depends on a viable urban ecosystem and with land for cultivation and practical knowledge of how to grow food. They conclude that urban food production has historically increased in times of need, but as urbanization continues to remove agriculture from metropolitan landscapes, the local and practical knowledge is also removed from the collective “know how” of food production (Barthel et. al, 2012). Urban agriculture can also help create or maintain social equity by providing land access and knowledge for growing food to marginalized community groups like women and children in developing countries- empowering women (Millenium Development Goal 3) and providing education opportunities (De Zeeuw, 2010; Surls, 2014) and fostering citizen engagement in the neighborhood via community gardening (Reynolds & Cohen, 2014; Golden, 2013).

b2. Environmental Issues

The unprecedented rate of urbanization while equally out-competing green spaces in cities has resulted in nearly a singular reliance on and continued growth of an industrial agriculture. The ecological effects of the contemporary industrial agriculture system were first exposed by Rachel Carson’s *Silent Spring* in 1962 (Viljoen Bone & Howe, 2005). These industrial, intensive, and highly modified agriculture landscapes can and do provide humans with food and fiber, but have caused severe environmental destruction by altering and replacing ecological processes while demanding high amounts of petroleum based inputs for production and distribution (Sandhu & Wratten, 2013). And the agro-chemicals used for weed and pest control were found to have significant consequences to human and wildlife health. At the same time, the unprecedented rate of urbanization and urban growth is driving ecosystem change while simultaneously requiring the goods and services, or food and fiber from the rural landscapes cities are so rapidly consuming to meet their daily needs Sandhu & Wratten, 2013).

Urban agriculture can provide multidimensional and multi-scaled environmental benefits to highly developed and arguably low biodiverse urban landscapes in an era of environmental literacy on food production. Urban agriculture can benefit urban regions and urban dwellers by preserving biodiversity, reducing waste, and reducing the amount of energy used to produce and distribute food (Viljoen, Bohn, Howe 2010). The reuse of wastewater and capturing storm water for irrigation can slow water discharge into rivers and streams while reducing the amount of fresh water used for irrigation (Buecher et. al, 2006 in De Zeeuw, 2010; Smit & Nasr 1996). Urban agriculture sites can also be a neighborhood or district sink for recycling organic wastes into compost that can amend urban soils, increase water infiltration, break down soil contaminants, and replenish soil nutrients while reducing the food waste stream from urban rural areas and keep valuable nutrients where they are depleted (Doherty, 2014; De Zeeuw, 2010; Smit & Nasr 1996). Urban agriculture can be a strategy for urban greening by activating existing parks and greenspaces, enhancing vegetation cover, and preventing risk prone land to be built on, further enhancing the biodiversity of the city such as the proposed Viet Village Farm (Mossup + Michaels 2008, Dubbeling et. al., 2009; De Zeeuw, 2010).

Productive landscapes in and around cities can reduce energy use and greenhouse gas emissions associated with producing and distributing food while reducing the costs of handling waste. The Food and Agriculture Organization (FAO) (2008; in De Zeeuw, 2010) states, “A paradigm shift in design and urban planning is needed that aims at... reducing the distance for transporting food by encouraging local food production...within city boundaries and especially in immediate surroundings.” This speaks to a citywide or regional model for productive urban agriculture landscapes in the work by Viljoen et.al. (2005) that envisions planned combinations of connected urban open spaces that combines urban agriculture and ecologically productive landscapes for social, recreational, and agricultural activities (Hodgson et.al 2011).

Urban agriculture can pose risks that could be addressed by basic management strategies (De Zeeuw, 2010, Hodgson et.al, 2011) and in most cases are not significantly different than those of rural agriculture. One of the most important potential health and environmental risks for UA is the use of soil and water contamination from industrial or household uses. In peri-urban areas outside of the city center, the improper management of livestock and manure, and intensive or careless use of agricultural chemicals and fertilizers may pose risks for abutting land uses. To this end, the inappropriate management of urban agriculture land uses may inherently pose risks for land use conflicts where differing land uses abut, even where organic agriculture practices are employed (De Zeeuw, 2010; Hodgson et.al., 2011).

Many of these risks for UA as a strategy for green and ecologically diverse cities are low. Policy changes and regulatory structures can address many of these potential risks, but municipalities have been historically slow to address policy changes for UA or include urban agriculture in comprehensive plans to include urban agriculture as a viable and beneficial urban activity (Mendes et.al., 2008). Cities, metropolitan regions, planning organizations, and city officials are beginning to address addressing policy gaps and planning for urban food production while understanding and accounting for the risks.

Conclusion:

Urban agriculture is practiced across the globe. Attention to this practice was most forcefully addressed by the UNDP report authored by Smit and Nasr (1996) out of the need to address increasing urbanization, the concentration of poverty and hunger in cities, and environmental degradation. Urban agriculture, or growing food in and around cities, over the last 20 years has experienced a renaissance in research and practice as those interested in the interface between food and the process of urbanization have realized this important, complex, and necessary field of investigation and study. Most, if not all, of the academic research echoed each other in increasing quantitative study of this phenomena to fully understand the social, economic, and environmental benefits of UA beyond anecdotal evidence.

Much of the academic research also concluded that because urban agriculture is practiced all over the globe and across a spectrum of spatial and production typologies, clear definitions and typologies for UA need to be developed that reflect the specific spatial and social structure of the city or ecological region to be studied. The research for this design project will provide a definition for urban agriculture and literature review of spatial and production typologies. This project is informed by the definition for and typologies of UA in the following sections as a means for incorporating these ideas into a spatial design for an urban agriculture research center. This proposal for reinvestment in the Waltham Experiment Station is intended to reflect the UA typologies that could be experienced in the Boston Metropolitan area and programmed for a “Learn by Doing” ethos consistent with the

traditional practice of UMASS Extension. This center can help address the specific challenges and barriers for a robust UA system inclusive of food production and the provision of valuable social services of educational outreach and applied knowledge, technical assistance, and researching and addressing the resource needs for UA in greater Boston.

c. Definition of Urban Agriculture

Urban Agriculture is summarized by Imbert in her Essay *Aux Fermes Citoyens* (2005) that; “Urban Agriculture is a loosely defined ideology with a long history.” Food provisioning has long occurred in and around cities (Barthel & Isenhdahl, 2012; Lawson, 2005) as a mechanism for providing sustenance. Food production and gardening programs in cities beginning with modernization began to address emerging social ideologies in times of need or crisis with such examples as Relief Gardens and World War II Victory Gardens that became a symbol for solidarity while providing income, food, and recreation. For much of the world today, the current crisis is one embedded in the industrial production methods and accessibility of food itself in an urbanizing world.

Urban agriculture (UA) can be briefly defined as; the growing of plants and rearing of livestock within or on the fringe of cities including input provision, processing, and marketing activities (Smit et. al 1996). This basic definition is widely accepted, but for the purpose of this project understanding the differences of scale, production, and mission of urban agriculture activities in relation to the spatial and social fabric of the city or region is important.

Urban agriculture in contemporary times is being used as an opportunity for realizing broad social and environmental change. Lack of an unclear definition for UA that results in broad catch-all list of urban agriculture landscape types can lead to unsuccessful outcomes for achieving sweeping social and environmental changes practitioners, community members, funders, researchers, designers, and city officials seek to make (Napawan, 2014; Surls, 2014). Urban agriculture typologies over time add complexity for a contemporary understanding of what urban agriculture is such as World War II era victory gardens giving way to community gardens.

Peri-urban agriculture, community gardens, victory gardens, community supported agriculture (CSA), entrepreneurial farms, farm-to-school, school gardens, work relief farms and allotment gardens are just a few of the common terms that may be used to describe urban agriculture projects (Lawson, 2005; Napawan, 2014) in different geographies over time. Each may suggest a different scale of production, geo-spatial location or reflect that the goals of an urban garden or community farm may be ancillary to growing food.

Laura Lawson (2005) provides an explanation of a few of these aspects of urban agriculture terminology noting that urban refers to the city, its suburbs, and the urban edge.

- Urban Garden Programs encapsulates various cooperative enterprises that provide space and resources for urban dwellers to cultivate vegetables and flowers. This includes current farm-to-school programs.
- Community Garden is probably more familiar to many people and dates back to at least World War I and tends to be associated with the “neighborhood garden” where individuals can have their own plots and share in the gardens overall management.
- Urban Garden can include more types of programs such as relief gardens, children’s gardens, entrepreneurial job training gardens, and demonstration gardens

The acronym UPA Urban and Peri-urban Agriculture was introduced by the Food and Agriculture Organization of the UN (FAO) (Zeeuw, Van Veenhuizen, M. Dubbeling, 2010) that suggests UA activities can be subdivided into 2 categories; (a) intra-urban, and (b) peri-urban. Intra-urban agriculture refers to agriculture that takes place within city centers on vacant land with limited tenure or public land, but is generally categorized as being small scale, subsistence oriented production with goals that foster community building and social capital via food production (Van Veenhuizen & Daso, 2007). Examples of this could include community gardens, home gardens, school gardens, and roof tops.

Peri-urban Agriculture takes place on the urban periphery where population growth and land use change is dynamic, resulting in agricultural production systems becoming smaller, increasing intensity, and production of perishable crops and animal production (Van Veenhuizen & Daso, 2007). Van Veenhuizen (2007), citing experiences from Cuba, Argentina, Viet Nam, and Lebanon, determined that peri-urban agriculture tends to be larger than intra-urban agriculture and more strongly market-oriented. The study of UA as a whole is often viewed as a continuum from urban fringe to city center (Surls, 2014) and activities range from community building and subsistence oriented projects to small and large scale commercial enterprises (Zeeuw, Van Veenhuizen, M. Dubbeling 2010). The acronym UPA (Urban and Peri-urban Agriculture simply covers the various typologies for growing food as it relates to the spectrum of urban development patterns. UA and UPA are therefore used interchangeably for this project.

Urban agriculture encompasses a broad scope and scale of food production means and methods from community garden plots to organized commercial scale farming. It has also emerged in recent decades as a venue for social change to disadvantaged urban residents and a symbol of environmental awareness for others. Taking the many variations, typologies, and motivations for growing food in and around cities, results in a refined definition of urban agriculture. Van Veenhuizen in *Cities Farming for the Future* (2006) provides the following more encompassing definition:

Urban agriculture can be defined as the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products. Urban Agriculture is located within or on the fringe of a city and comprises of a variety of production systems, ranging from subsistence production and processing at the household level to fully commercialized agriculture (Chapter 1 p-2).

This definition for UA can be enriched by a few other key characteristics such as;

closeness to markets, limited space, use of urban resources such as organic wastes and wastewater, and mainly produces perishable items and lastly that "urban agriculture to a large extent complements rural agriculture and increases the efficiency of a national food system" (Van Veehuizen, 2006).

Lastly Mougeot (2000; in Van Veehuizen, 2006) concludes that:

the most distinguishing characteristic of urban agriculture is not so much its location or the aforementioned criteria... –but the fact that it is an integral part of the urban economic, social, and ecological system. It uses urban resources (land, labour, organic wastes, water), produces for urban citizens, influenced by urban conditions (policies, competition for land, urban markets) and impacts the urban system (food security and poverty, ecological and health impacts) (Chapter 1 p-2).

This concluding point may be the most important criteria for understanding urban agriculture as a system within the nexus of urban infrastructure and integrated into the form and function of a city and region. This paper will use the following definition and characteristics to define urban agriculture for this project;

Urban agriculture (UA) is the growing of plants and the raising of animals for food and other uses within

and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products. The first characteristic is that it is an integrated part of the urban economic, social, and ecological system from city center to the urban fringe and includes a variety of production intensities from household subsistence, to commercial agriculture and can include a range of goals for addressing social and environmental justice in urban areas. Second, it is complementary to rural agriculture in that urban agriculture is a model for increasing efficiencies for provisioning food while reducing environmental degradation and removing socio-economic barriers to healthy and nutritious food.

d. Growing Food Production in Cities- A Brief History

d1. Ancient Settlements/ Walled Cities

Food production in cities is as old as the “city” itself. Ancient civilizations like Constantinople persisted for thousands of years on a food network that included agricultural practices within and just outside of the boundaries of the walled city (Barthel & Isenthal 2012). Mayan cities across the Yucatan Peninsula (1000 B.C. to 1500 AD) established food cultivation networks from the regional scale down to individual garden plots (Barthel & Isenthal 2012). These ancient civilizations, not only understood the role of a food production network, but in fact established a spatial order of the settlements and cities to allow for such a system (IMAGE above ref).

Barthel and Isendahl (2012) describe patterns of Maya settlements as dispersed, low density settlements with a core of buildings and spaces for ceremonial elite residential uses. The low density city was created by clusters of household compounds and associated garden spaces that formed a farmstead (Dunning, 2004; in Barthel & Isendahl, 2012). Regionally, Maya civilization developed a total food resource framework that employed a composite agro-system referred to as “managed mosaic” by Fedick (1996; in Barthel & Isendahl, 2012) that characterizes the diversity and complex spatial and scalar distribution of Maya food and resource management regionally, sub-regionally, city wide, and down to the neighborhood or farmstead (Barthel & Isendahl, 2012). The spatial patterning of the total food resource framework created a strategic system that could manage and provide high biodiversity (Dunning, 2004; Ford and Nigh, 2009; Isendahl, 2002, 2010, in press; Killion, 1992; Netting, 1993; in Barthel & Isendahl, 2012). The farmstead located key ecosystem services in the center of the settlement, including food provisioning, and supporting regulating and cultural services (Barthel & Isendahl, 2012).

Byzantine Constantinople (4th century A.D. to 1453) is widely studied but not until recently was its system for the provisioning and storage of food and water discovered (Barthel and Isendahl, 2012). The need for reliable food and water sources in a time of regional political, cultural, and economic conflict led to a need for local production within the walled city (urban) and just beyond city walls (near urban) (Haldon, 1990 in; Barthel & Isendahl, 2012). Urban agriculture systems formed complex webs of different social groups and organizational structures from household gardens and animal husbandry to large orchards and cultivated land. A second wall around the city was constructed, not due to population growth but to protect the cities resources from conflict, which enclosed reservoirs and open space for pasture and cultivation strengthening the system urban and near urban agriculture.

d2. Urban Food Production in Modern Cities

The allotment garden system of European cities flourished in times of need as nations transitioned from feudal agrarianism to urban industrialism from the 17th through the 19th centuries (Barthel,

Parker & Ernston 2015). In Britain, the privatization of previously common land dissolved the ancient system of local food production, causing the poor to live at or below subsistence levels (Barthel, Parker & Ernston, 2015). Social movements, and economic and political crises led to the creation of laws allocating space for allotment gardens, which provided important and necessary buffers from food shortages (Barthel, Parker & Ernston 2015;) Allotment gardens played an important part for providing vegetables in Britain during World War I (House of Commons, 1998 in; Barthel & Isendahl 2012), then becoming more widespread across Europe and the United States During World War II (Barthel & Isendahl 2012; Lawson, 2005).

Growing food in cities and towns in the United States began to emerge in concerted efforts around 1890 as urban gardening or urban gardening programs. Urban garden programs waxed and waned in relation to political and social crises, precedents similar to that of European cities. The following discourse on the history of urban gardening in America is mostly cited from Laura Lawson's (2005) seminal book that thoroughly and clearly covers the links between urban gardening, the social and economic and political context of the 20th century, and the associated changing relationship between city and countryside. Lawson (2005) developed through her research 3 distinct, but related chronologies; (1) Early Garden Programs- 1890 to 1917 (just before the U.S. entered WWI), (2) National Urban Garden Campaigns-1917 to 1945, (3) Gardening for Community- 1945 to Present.

Urban gardening programs and associated support between the 1890's up to World War I were a small but important gesture among many proposals for urban reform to address urban congestion, economic instability, and environmental degradation such as poor water quality, inadequate sewage and sanitation and pollution (Lawson 2005). At the same time, the economic depression of the 1890's led poor rural residents to abandon rural farms for economic opportunities in cities and an increased demand for cheap food (Tanaka & Krasny 2004).

School garden programs and vacant lot cultivation were expressions of education and social reforms respectively where land and technical assistance could teach civics and good work habits for students and the unemployed alike (Lawson, 2005). These programs were part of a greater social and aesthetic agenda supported by municipalities, the Department of Education, civics leagues and gardening clubs that exemplified the urban ethos of the time- The City Beautiful Movement. These urban garden programs and the groups that supported them where expected to simultaneously improve both the environment and behavior of participants- provide a venue of the moral, physical, and economic development of the poor, but also result in a cosmetic improvement on the unattractive urban environmental conditions (Lawson, 2005).

Vacant city lots where offered to poor residents for growing food (Lawson, 2005; Tanaka & Krasny, 2004). Detroit had one of the more successful programs that during the course of the program reduced the cities "poor roll" by 60% and spawned other vacant lot cultivation programs in New York and Philadelphia by 1897. Nineteen other cities reported such projects by 1898 (Lawson, 2005). The primary source research by Lawson is hauntingly prescient as both Detroit, Philadelphia, and New York City each have emerged as important cities for tackling urban social issues through the cultivation of food.

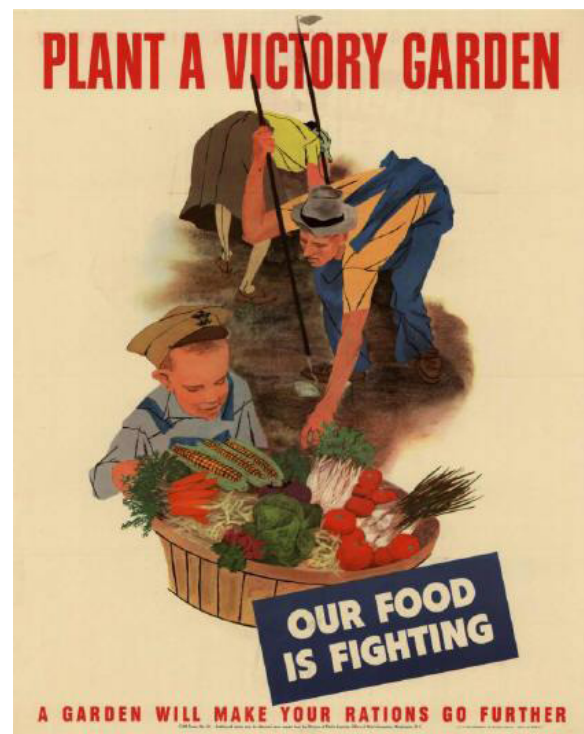
The First World War, Great Depression, and World War II signified a new phase in social and environmental challenges. Garden programs continued, their "restorative activity to counteract urban conditions, (Lawson, 2005 p113)," but where earlier programs targeted children or the poor, relief gardens and Victory gardens of this era took on a populist appeal. Along this same timeline, technological advances led to mass agricultural production, continued urban migration, and

suburban development marked the beginning for urban gardening as a hobby for multi-beneficial outcomes like food security, nutrition, and recreation.

According to Lawson (2005) “the most marked distinction of garden programs between World War I and II and preceding movements is the shift to an organizational approach that blended top-down guidance with bottom up action (pp-114).” Gardening was included in domestic conservation programs conceived by the U.S. Food Administration and the Council of National Defense. Voluntary organizations like the National War Garden Commission, and several national women’s federations provided pivotal connection between federal agencies with technical support by agricultural colleges and local volunteers for war gardens, depression era gardens and farms, and Victory Gardens. American food supplies during World War I would need to be increased to not only meet the demand for American supplies, but also for export to European allies. Government agencies like the USDA with support from the War Department and agricultural colleges increased rural agriculture production through education programs, extension services, and market distribution (Reynolds, 2011; Lawson, 2005). Domestic food needs would be met in part by increasing rural agriculture, but also through a national war garden that coordinated the efforts of families, individuals, and institutions to produce food. Local efforts were led by government and non-governmental agencies such as the Food Administration, the National War Garden Commission, the Woman’s Committee of the National defense Council, and the U.S. School Garden Army (Lawson, 2005)

A new round of urban garden programs emerged with the onset of the Great Depression with initial support from municipal governments, commercial industry, and civic groups- the federal government didn’t act until Roosevelt’s Federal Emergency Relief Act. Two types of programs emerged; (1) subsistence gardens where households grew food for their own consumption; (2) work relief gardens that employed men at an hourly rate to grow food and distribute to institutions and the poor (Lawson, 2005). According to Bassett (1981), large tracts of land ranging from 5- 10 acres would be donated or leased to municipal garden committees then subdivided into plots or allotments 50’x 150’ for subsistence gardening. Work relief gardens, or industrial plans were organized under the premise of mass production.

The benefits of each type of depression-era garden could be debated where the individual plot or subsistence garden provided not only food, but the “joy of possession (Bassett, 1981, p-5)” for those who not their jobs, savings, and even house. The work relief gardens or industrial model benefited the community as a whole, provided the greatest amount of food, and closely resembled that of factory work from which many were unemployed (Bassett, 1981). Many methods were employed to increase food for a community during the great depression- Wabash, Indiana for example under the supervision of the Wabash Garden club had 700 home gardens, a municipal industrial garden, and 300 individual plots on vacant land (Bassett, 1981)



WWII Victory Garden Flyer,
Source; Victory Garden Foundation

- a veritable urban agriculture system in the 1930's.

World War II Victory Gardens focused on maximizing agricultural efficiency while mandating rationing (Lawson, 2005). This period in human history dawned the modern age of engineering and efficiency, and urban gardening focused on smaller household plots of 20'x25' (Bassett, 1981) for promoting nutrition and recreation for the family and social returns in solidarity for the war effort. The USDA and the War Food Administration programs encouraged residents to grow their own food so more rural agriculture production could be sent to armed forces, leading up to 44% of the nation's vegetables grown in Victory Gardens (Reynolds, 2011).

By the 1960's, the populist era of War Gardens, Victory Gardens and relief gardens and farms were almost obsolete amidst urban decline and suburban sprawl. A few remaining school gardens and Victory gardens existed in urban areas, such as the Fenway Victory Garden in Boston, Massachusetts, currently active today as the Fenway Community Garden (Lawson, 2005; Warner & Durlach 1987). Urban decline renewed the interest in urban green spaces and the contemporary gardening movement in the late 1960' and early 1970's (Tanaka & Kresny, 2004). Faced with racial tension, declining urban population, abandoned properties, and urban renewal projects that were tearing neighborhoods apart, local residents and activists of American cities sought to reclaim and rebuild communities and expand the open space resources in their neighborhoods through gardening (Lawson 2005). Additionally, self-reliance amid the energy crisis, rising food prices, and an emerging environmental consciousness sparked a renewed interest in urban gardening.

Urban gardens of the late 1960's 1970's continued the pattern of civic duty affecting the living conditions of urban dwellers similar to bygone programs of the 1890's, but the emergence of a new name, 'Community Garden' suggested not only a new type of garden, but stood as an expression of grass roots activism (Lawson 2005). The Fenway Community Garden may be one of many examples of this where repeated efforts to remove the gardens from the site and develop it for other uses including a hospital, a school, and a parking lot on three separate occasions- each time public and political support helped retain the garden space (Warner& Durlach, 1987; Lawson, 2005).

A vacant lot program in Philadelphia, beginning in 1964, is another important benchmark for government support and urban food production where a county Cooperative Extension coordinator began cultivating vacant lots in the wake of social unrest (Reynolds, 2011). The USDA initiated the Urban Garden Program (UGP) in 1976 which employed extension staff to "assist in teaching and demonstrating gardening and 4-H type work as well as nutrition assistance for low-income families" in cities (Shaller, 1977, cited in Stephens et. al., 1996, p.294; Reynolds, 2011). By 1989, Hynes (1996) reports that 3,000 UGP staff and volunteers worked with 200,000 low income urban gardeners producing \$22.8 million worth of produce on a budget of \$3.5 million (in Reynolds, 2011).

Throughout the 1970's and 1980's the focus of urban gardening was community - those who organized and maintained the gardens, but also the impact the garden had on the neighborhood, city, and larger society (Lawson 2005). In an age of deteriorating urban infrastructure, urban gardening added a sense of resilience for social and physical reclamation.

Recent trends in urban gardens show that the movement has continued to evolve and now encompasses a broader ideal. Lawson writes that in 1999, the American Community Gardening Association reported that half a million people were engaged in urban garden activities (2005). Its membership included the individual gardener, neighborhood groups, extension agents, designers, and social service providers each participating in neighborhood and school gardens, job training

programs, and other types of programs whose goals were determined by their context and participants (Lawson 2005).

This movement continued to evolve seeking a broader influence on matters of community development, social justice, education, and environmentalism and the American Community Gardening Association (ACGA) weighed changing its name by removing “gardening” and inserting “greening” that would suggest a stronger relationship between human settlement and plants as a catalyst for empowerment, connectedness, and common concern.

Across the globe and across time the urban gardening for food production has been a human response to a litany of environmental, social, and economic crises. Today, urban agriculture encompasses a broad spectrum of players has many layers from the user groups and funding to its urban context and the goals associated with any given program. Lawson writes that the core cultural values that find expression in the urban garden are; the value of nature in the city and the value of individualism and that those values influence the program at any given urban garden (2005). Lawson continues that “garden programs serve to further a vision of what should be in times when society is unclear about where the future is heading” (2005).

d3. Cuba- An Important History

Cuba has emerged as an international case study for an alternative food system for UPA in the face of economic and political crises. The island’s major trading partners disappeared almost overnight with the disintegration of the Soviet Union in 1989, and the world’s leading sugar producer since

1860, lost a majority of its trade capacity (Diaz & Harris 2005). The country emerged as the pinnacle for urban agriculture in the face of being completely cut-off from necessary food and raw materials imports during the fall of Communism in the early 1990’s while equally succumbing to the economic loss of exporting sugar- its most valuable crop.



Urban Agriculture in Cuba
Source; urbanfoodjustice.org

The revolution in 1959 brought with it agricultural reforms that developed Cuba’s National Agriculture sector into a highly mechanized system dependent

on agriculture imports for increasing sugar production but also for food. These reforms followed a communist model of spreading the wealth, but ultimately resulted in environmental degradation ranging from large scale deforestation to soil degradation, erosion, and fertility loss (Funes 2002; Cisernos 2012) Cuba’s agricultural sector imported 100% of the country’s wheat, 90% of beans, 48% of fertilizers, and 82% of pesticides not to mention oil and replacement parts for equipment (Diaz, Harris 2005). More specifically, 55% of calories, 50% of proteins, and as much as 90% of fats were imported from other socialist countries. In 1989, the collapse of the Soviet Union eliminated Cuba’s ability for trade leaving the country on the brink of economic collapse and in a food security crisis.

The inspiring atmosphere associated with the revolution included the division of land and spreading

of wealth - some of which was given to small scale farmers. In Havana, a green belt was proposed that signaled a change in the infrastructure of agriculture where the capital city would overcome its dependence on food from more rural territories. The objective of El Cordon de La Habana (Havana Green Belt) was to provide the city with a productive surface that would empower self-feeding capacity but also provide it with a number of recreational areas for the urban population (Diaz & Harris, 2005). This green belt plan called for a fruit tree belt closest to the city, a milk producing belt, pasture, and forestry zones that included tree plantings for wind protection, the development of dams for irrigation, and houses for farmers and workers (Diaz, Harris 2005).

Four years prior to the Soviet collapse, the National Institute of State Reserves began studying hypothetical scenarios such as a complete cut-off of petroleum (Koont, 2008). Collections of raised garden beds called "*organoponicos*" were installed at Armed Forces facilities and by 1991 the first civilian *organoponico* was installed. It has become a mainstay of vegetable cultivation in Cuban urban agriculture and by 1994 a national commission had been started to oversee development of these installations and other intensive agriculture uses (Koont, 2008). Simultaneously, the Soviet form of state owned land began to unfold, and land was distributed to individuals and cooperatives were formed (Koont, 2008) and a shift away from large scale sugar encouraged more organic vegetables and fruits.

In 1958, just before the revolution, only 44% of the population resided in urban areas (Nova, 2009). Urban dwellers now make up 75% of the country's population (Diaz & Harris 2005). This continued urbanization and the aftermath of an economic crisis is the context for which urban agriculture has developed and continues to evolve in Cuba. After this crisis, an alternative model of agriculture was pursued and its socio-economic benefits of food production and nutritional value have been emphasized, but also its job training and increasing environmental awareness dimensions are equally valued. The Cuban urban agriculture experience is best described by Gonzalez Novo and Murphy (2001) as the "the world's first nationwide coordinated urban agriculture program, integrating access to land, extension services, research and technology development, new supply stores for small farmers, and marketing schemes and organization of selling points for urban producers" (in Diaz & Harris 2005).

Conclusion

The spatial and functional relationship the ancient cities and settlements had with food and fresh water provisioning offers insight into the shape and function of contemporary cities. The examples of Constantinople and Maya settlements demonstrate that these civilizations understood that food and water security are dependent on scale, spatial complexity, and access to resources. Maintaining food and water resources and nutrient cycling in proximate vicinity of the point of consumption also maintained biodiversity, habitat, and ecosystem services while equally co-existing with humans for centuries- arguably in times of greater warfare and political and economic conflict than modern times. Lastly, though these ancient civilizations were stratified across race and class, it's arguable that practical knowledge and management for water and food linked cultures, generations, and social divides within cities and settlements.

There are many overlaps in modern-era examples of urban agriculture from intensity of production, scale, and goal of the program, often initiated in response to some crisis. Many of the differences exist simply on a temporal scale as a clear socio-economic connection could be made between the *organoponicos* in Cuba to war and relief gardens and allotment gardens in the early to mid 20th century. Two learning lessons for the United States can be gleaned from the Cuban Model: that success of urban agriculture programs is based on 1) a strong commitment from governmental

organizations and agricultural extension services and 2) that urban land that otherwise has potential for development should be protected as part of an urban food infrastructure system similar to or nested within regional park system plans. These lessons both directly apply to the UMA Waltham Field Station.

At a time when food has seemingly reached the top of the social agenda for addressing social and environmental justice, considering it the savior for the ills of urbanization may place it in the historical context of subsiding from the social agenda when the crisis ends- a lethal blow for advocates of an alternative and sustainable food system. Urban agriculture as a contemporary practice and ideology represents more than just growing food for sustenance, but is in jeopardy of becoming an undefinable, amorphous, and impossible solution for environmental degradation, social justice, and creating economic opportunities for vulnerable urban dwellers. Research for and the practice of UA must have a clear definition and goal(s) that reflect the spatial and socio-political context of the region, city, district or neighborhood this activity seeks to serve. Equally, the practice and function of growing food in cities has historic precedent, and urban dwellers dating back to ancient civilizations have long understood the social and ecological benefits that networks of green spaces for production and leisure provide society.

e. Urban Agriculture & Ecosystem Services

Urbanization can generally be defined as a global multidimensional process of rapidly changing human population densities and changing land cover (Brueste, Haase, Elmquist, 2013). This process occurs at multiple scales and influences environmental changes far beyond the city, region, or national boundaries (Mcgranahan et. al., 2005; Brueste, Haase Elmquist, 2013) while requiring surrounding rural landscapes to fulfill daily needs of food, water, and materials (Sandhu & Wratten, 2013). Globally, urban sprawl is altering the processes and functions of natural ecological systems and critical habitats (Brueste, Haase Elmquist, 2013), while locally altering ecological processes that encourage the formation of urban heat islands or reduce recreational or cultural values of the land.

Urbanization and population growth relies on the global industrial agriculture system that has increased environmental degradation in rural and urban settings alike. Notably, Rachel Carsons's *Silent Spring* published in 1962 triggered concern over the ecological side effects and health risks posed by modern agriculture (Viljoen & Bohn, 2005). Industrial agriculture has only intensified with technological advances and urban migration, but increasing intensity relies heavily on energy and oil inputs, pesticides, and farming techniques that have increased ecological degradation (Sandhu & Wratten 2013). The Millennium Ecosystem Assessment (MEA)(2005) that provided a framework for analyzing socio-ecological processes suggested that "agriculture may be the largest threat to biodiversity and ecosystem function of any single human activity (pg. 10 in Sandhu & Wratten, 2013). The environmental consequences of mainstream agriculture has led worldwide concerns about food security in an era where population projects, climate change, and 'peak oil' will only demand increasing yields (MEA 2005; Sandhu & Wratten, 2013).

Considering these trends, this project posits that urban agriculture can be an alternative model for food production by providing locally-produced food for urban dwellers while enhancing ecological systems in urbanized landscapes. The capacity for urban agriculture needs to be carefully considered within a local social, and economic, and environmental context, with the objective of complimenting the global food system by fostering a broad social and environmental paradigm.

The concept of ecosystem services provides an apt framework for addressing the broader implications and potential benefits that UA can provide beyond growing food. The EU 2020 Biodiversity Strategy explicitly states that biodiversity and ecosystem services are the “underpinnings of employment, economies, wealth, and wellbeing (European Commission 2011 in Plieninger et.al. 2012). Ecosystem services are defined as the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly (de Groot, 1992). No single category can capture the diversity of what fully functioning ecological systems provide humans. Ecosystem services occur at multiple scales, from climate regulation and carbon sequestration at the global scale to soil formation and nutrient cycling at a local scale (Sandhu, Wratten 2013) and benefits humans receive range from water and climate regulation, biodiversity and pollination, to aesthetic and recreational services (Brueste, Haase Elmquist, 2013). Ecosystem services are typically categorized into the following four groups;

- Provisioning Services- food and timber production, water supply, provision of genetic resources
- Regulating Services- regulation of climate extremes such as heavy rainfall and heat waves, floods and diseases, regulation of water flows, treatment and handling of waste
- Cultural Services- recreation and tourism, provision of aesthetic features, spiritual requirements
- Habitat and Supporting - soil formation and processes, pollination or energy, matter and nutrient fluxes, biodiversity (MEA, 2005; Costanza et.al., 1997; TEEB, 2011; Brueste, Haase Elmquist, 2013)

Cities and agriculture landscapes are both consumers and providers of ecosystem services. These services are important considerations given the trends in population growth and urbanization and ecological degradation caused by these highly managed- or engineered- landscapes (Convention on Biodiversity 2010; Brueste, Haase Elmquist, 2013). Ecosystem services that are both requested and provided in urban areas and cities can be defined as urban ecosystem services (UES) (Brueste, Haase Elmquist, 2013; Boland Hunhammar 1999). Many urban ecosystem services are provided to city residents via urban green spaces such as forests, trees, parks, allotments and cemeteries (Brueste, Haase Elmquist, 2013). This categorization of green spaces can be broadened to include the lesser managed, though highly influenced by city functions, waste spaces and vacant or idle landscapes characteristic of former industrial sectors of cities or neighborhoods and cities experiencing population loss.

Urban agriculture involves activating urban greenspace and underutilized land for food production while increasing urban ecosystem services. Urban agriculture can be assessed across a linked spectrum of spatial and production scales and typologies. When this activity is viewed through the framework of UES, the implications that UA can have for improving the urban living can be more clearly addressed. It is widely cited that urban agriculture can increase access to healthy and nutritious food (Zeeuw, Veenhuizen, Dubbeling 2010; Mougeot, 2000; Smit 2001; FAO 1996) thus, reducing hunger while also improving biodiversity and social cohesion from city center to urban fringe (Doherty, 2015; Zipperer & Pickett, 2012). One critique of industrial agriculture practices is the increase in water pollution and soil degradation, yet Edmonson et. al., (2014) found that storm water retention and soil quality are maintained in urban community gardens and that urban gardens serve an important function for wildlife and are rich in biodiversity (Gardiner et. al., 2014; Matteson & Langellotto, 2010; in Doherty, 2014).

According to Lin, et.al. (2015) there are gaps in the research regarding the ecosystem service

benefits directly resulting from urban agriculture, however some conclusions can be drawn based on research of urban ecological systems and communities and the scientific research on environmental degradation associated with industrial agriculture production and consumption. Ecological functions in cities can be enhanced by growing food in vacant lots, increase pollinators for biodiversity, and ameliorate food deserts (Pickett 2012). Waste water and stormwater runoff can be re-used for irrigation and solid waste can be composted to return nutrients to the soil, thus decreasing the demand on natural and engineered systems to handle wastes (Zeeuw, Veenhuizen, Dubbeling 2010). Urban agriculture can enhance vegetation cover with important adaptive and mitigating factors by removing impervious surfaces and allow for increase stormwater infiltration (Dubbeling et. al 2009).

These ecosystem principles of landscape ecology are being connected to the call for an increase in urban food production as integral component of urban green space networks. The design and planning professions have responded with written works like Viljoen (2005) CPULS's (Continuous Productive Urban Landscapes) (Viljoen, 2005) and visionary design work like Michel Desivignes' Lesiere in Paris that proposes landscape ecological functions and urban agriculture can create a new spatial framework for cities (Imbert, 2010). However, much of the study and visionary work on linking these benefits of urban ecosystem services and food production as a function of urban greenspaces often omit the cultural benefits provided by such urban greenspaces.

e1. Cultural Ecosystem Services

One of the over-arching and re-occurring themes in Lawson (2005) are the broad benefits for social capital and community building provided by urban gardening over the last century in the United States. Gardens of the Relief era to modern day community gardens each have not only provided opportunities for growing food, but also a support network that included leisure and recreation to skill development, job training, or recreation for in solidarity with the given social or economic climate of the time. These broad social benefits are also recognizable by the socio-political support for the system of UPA in Cuba that not only encouraged and supported citizen farmers, but provided outreach, training, and technical education resources. These recreational, educational, skill development, and cultural practices for growing food are examples of cultural ecosystem services.

Cultural ecosystem services (CES) are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (MEA, 2005; Milcu, et.al., 2013). Cultural ecosystem services are often omitted or unrecognized in the study of landscape ecology, design and planning even as the MEA 2005 acknowledges the importance of the combined influence on human wellbeing of ecosystem services (Tengberg, 2012). Studies determined that some of the challenges for incorporating the benefits of CES is; intangibility and that the physical, emotional, and mental benefits provided by CES are often subtle and intuitive (Milcu et.al., 2013), there is an inherent difficulty of establishing a clear relationship between CES and other elements of an ecosystem and the poor capability of assigning value or economic indicator (Hernandez-Morcillo et. al., 2013; Miclu), and the lack of clear definition and categories (Plieninger et. al., 2013;).

The MEA (2005) established the following categories for CES.

- **Spiritual and religious-** many societies attach spiritual and religious values to ecosystems or their components.
- **Recreation and ecotourism-** people often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.
- **Aesthetic-** individuals find aesthetic value in various aspects of ecosystems, as reflected in support for parks, scenic drives, and selection of housing locations.

- **Inspirational-** ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.
- **Sense of place-** ecosystems as a central pillar of “sense of place”, a concept often used in relation to those characteristics that make a place special or unique as well as to those that foster a sense of authentic human attachment and belonging.
- **Cultural heritage-** many societies place high value on the maintenance of either historically important landscapes (“cultural landscapes”) or culturally significant species. The diversity of ecosystems is one factor contributing to the diversity of cultures.
- **Educational-** ecosystems and their components and processes provide the basis for both formal and informal education in many societies. In addition, ecosystems may influence the types of knowledge systems developed by different cultures.

MEA States Importance of CES and its values are not currently recognized in landscape planning and management and that these fields could benefit from a better understanding of the way in which societies manipulate ecosystems and then relate that to cultural spiritual and religious belief systems (Tengberg, et.al., 2012). MEA (2005) also states that the ES approach implicitly recognizes the importance of a socio-ecological system and that policy formulations should empower local people to participate in managing natural resources as part of a cultural landscape, integrating local knowledge can institutions.

This project proposes the reinvestment in the Waltham Experiments station, a once prominent educational, research, and outreach institution for agriculture when the greater Boston metropolitan area was still rural. This experiment station, now obsolete, can be reinvented as an epicenter for urban agriculture across metropolitan Boston that provides extension services with a new model for research, education, and outreach to address the challenges of an urban agriculture system. Equally important, it can be a center for experimental learning and a living laboratory to monitor and document CES, and more specifically, educational CES provided by urban agriculture. Urban gardens in the United States had some form of education component often provided by garden clubs and university extension services until the late seventies when urban gardens became aligned as an expression of social activism (Lawson 2005). However, education and social connectivity may actually have been increased (though without formal education) during this time as urban gardens became a gathering space for communities. The Waltham Experiment station can not only provide research and outreach to reduce the barriers for a robust UA system, but also monitor and document these important cultural ecosystem services provided by education.

Cultural ecosystem services provided by urban agriculture are important components for this project and have precedent. Education and outreach relevant to urban farming, production, and marketing are important concepts to make urban agriculture a viable component of an urban green infrastructure. Cuba’s urban agriculture system has been viewed as a successful model for education and outreach to urban dwellers interested in urban food production. The most important principle underlying this spectacular success is organization: strong, disciplined, coherent central direction and guidance are combined with decentralized action in input provision, marketing, and production (Koont 2008). Equally important to this project is the role that Cuban universities have played in its urban agriculture success. Cuba has long placed an importance on research and development, and had a plurality of scientists and engineers working across 19 agriculture institutes with several universities specializing in field and academic research leading to doctorate degrees (Koont 2008). By the early 1990’s, there had been much research on agro-ecological techniques by scientists whose research and findings were passed to farm workers via governmental extension agents- this provided a unique combination of qualified teachers and teachable students which allowed for the spread of

agro-ecological knowledge (Koont 2008).

Gonzalez, Novo, and Murphy (2001) have described the Cuban experience as the “world’s first nationwide coordinated urban agriculture program, integrating access to land, extension services, research and technology development, new supply stores for small farmers and new marketing schemes and organization of selling points for urban producers (Diaz, Harris 2005).” Finally, in an effort to understand ecosystem services to be directly provided by urban agriculture and the importance for increasing urban biodiversity, Bin, et. al (2015) acknowledge that a quantitative review or meta-analysis of those specific habitat and landscape features of urban habitats (including gardens) that correlate with increases in species richness and abundance of biodiversity in general. They continue in their research to contend that a lack of information to alter gardening methodologies and the ineffective transfer of knowledge are often two barriers for improving the sustainability of urban gardens (Goddard et. al 2013). They cite Barthel et. al (2010) and Colding et. al. (2006) that local ecological knowledge is generally low among urban residents; however, discussion between community members may encourage biodiversity friendly gardening, either through neighborhood or community exchanges of information (Bin et. al 2015).

This visionary project provides an outlet for increased education and outreach for making urban agriculture in the United States a viable long term component of urban green infrastructure. This project will provide an urban outreach and teaching venue for the University of Massachusetts to extend their teaching and training capabilities to a range of urban dwellers, from gentleman farmers hanging on to 1 acre lots at the cities fringe to urban activists looking to empower their communities through growing food and reorganizing blighted neighborhoods.

f. Project Statement

Urban and peri-urban agriculture has a new place in urban landscapes because of the suite of ecosystem services it can provide including; increased local food production, waste recycling, stormwater infiltration, and reconnecting urban dwellers to their food source. The University of Massachusetts Amherst (UMA) Waltham Experiment Station, once an important field station for agriculture research, is poised for *urban* agriculture reinvestment and could be a model for multi-use urban agriculture production, research, and education as well as a living laboratory to monitor and document the ecosystem services provided to the surrounding urban community. Research and claims made for the potential benefits provided by urban agriculture to urban dwellers is vast, but equal to this are the challenges and barriers for strengthening UA as an integrated system in the urban fabric.

While much has been written on the implications of these tendencies for local or urban agricultural production, public policy, and food as an element of culture, little has been written on the profound implications of these transformations on the shape and structure of the city itself (Waldheim, 2010). This project will not propose a city wide transformation for a local or urban agriculture system, but it posits that reinvestment in the Waltham Experiment Station for applied research or “learning by doing,” providing technical assistance, and education and outreach programs, can reduce barriers for such a city or regional urban agriculture network. The claims by research that the potential benefits, other research suggests that for UA to be sustainable new research needs to address the challenges and barriers for UA. University and cooperative extension is one vehicle for reducing those challenges.

This project is foremost about the broad role that urban agriculture can have in making cities

more livable and green spaces more active. The goal of this project is to provide a master plan for the University of Massachusetts Extension Service (now The Center for Agriculture, Food, and the Environment) Waltham Experiment Station that can apply research, address resource needs, and provide technical assistance for the spectrum of urban agriculture and related activities. This goal will be met by; a review of the relevant literature on the role that extension services can have for strengthening an urban agriculture system; a site analysis that revealed the complex layers for integrating existing and proposed site uses in the social and ecological context of Waltham, Massachusetts; cultural ecosystem services provides an apt framework for evaluating the potential social benefits provided by increasing the use of greenspaces for food production and increasing knowledge and education on food and food access issues.

Chapter 2 of this project will provide a literature review that covers the range of spatial and production typologies for urban agriculture This project does not research the typologies of urban agriculture around Boston, but through understanding the range of typologies for UA across geographies makes the case for an UA research, educational, and technical resource center based on the challenges and resource needs to make UA a viable urban system. In order to do this, the literature review will also cover the role that Land Grant University and cooperative extensions services could play in providing educational and technical resource needs for UA- a traditional activity extension provided rural agriculture. Chapter three will provide two case studies that have provided cultural ecosystem services through urban agriculture. Chapters 4 and 5 address the specific site conditions and design proposal respectively.

2. LITERATURE REVIEW

Growing food in cities often has more meaning beyond the provision of food for urban dwellers. Its presence in cities has been shaped by the relationship between the socio-economic climate and the built environment over time. The academic literature addressing this layered history of growing food in cities can be found across many disciplines including landscape architecture, planning, public health, ecology, agriculture, and soil sciences. Given this range of academic study and the fact that the global phenomena of growing food in cities often reflects the particular socio-economic and built environment of a specific city or region, the study and practice of Urban Agriculture (UA) is often difficult to categorize. One of the challenges for this project has been the synthesis of urban agriculture research across a wide range of study while identifying ways to add to the body of research.

This literature review will focus on two challenges for the successful study and implementation of UA. The first subject will review the literature on the development of urban agriculture typologies and how they can be used to add depth to defining and understanding urban agriculture concepts and practice. The second subject of this literature review will address the role that Land Grant University Extension Services can have in strengthening urban agriculture. The context for subject 2 comes in the form of the challenges faced by and the needs for urban food production for which extension and thereby, the redevelopment of the Waltham Experiment Station to address such challenges and needs for urban agriculture.

The key seminal texts advocating for urban agriculture as a framework for encouraging more sustainable cities and connecting productive urban landscapes to social health, economic returns and addressing environmental concerns include Jac Smit and Joe Nasr's 'Urban Agriculture for Sustainable Cities: Using Waste and Idle Land and Water Bodies as Resources' (1992) which led to the United Nations Development Program's (UNDP) Urban Agriculture: Food, Jobs, and Sustainable Cities (1996); William Rees' 'Cities Feeding People' (1996); Bakker et al.'s Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda (2000); Rene van Veenhuizen's Cities Farming for the Future (2006); and Charles Lester's 'Urban Agriculture: Differing Phenomena in Differing Regions of the World' (2006) (Napawan 2014). Napawan (2014) writes that each text takes a global position approach to the definitions and benefits associated with urban agriculture, and cites Lester (2006) that more than anything, these texts reveal a collective sense that urban agriculture has almost as many definitions as locations. Much of the recent academic literature identifies gaps in the research and practice. Two broad but common themes include providing clear definitions and typologies for UA (Napawan, 2014; Reynolds & Cohen, 2014; Reynolds, 2011) and in general increasing the local knowledge of UA. This chapter will address these challenges in the following sections through a review of UA typologies in section 1 and a review of the literature on the need for Land Grant University Extension Services to play a role in providing an increase in the research, education, and technical assistance for UA.

a. Typologies of Urban Agriculture

Urban agriculture is a multidimensional activity that can be better studied and implemented by identifying the spectrum of UA practice in relation to the needs of a neighborhood, city, and region in which it takes place. At the same time, the study of UA across disciplines can help identify the range of community needs and potential benefits provided by UA, but should concomitantly provide

definitions and typologies for UA relative to the socio-economic climate and geographic location of the study and practice (Hodgson, et.al., 2011; Napawan, 2014).

In the book, Continuous Productive Urban Landscapes (CPUL'S) (2005), Jeremy Iles succinctly compares urban agriculture activities in the UK to more urban agriculturally-productive countries like Cuba in the following excerpt:

Do we have a form of urban agriculture in the UK? If compared to the examples from Cuba or some African countries the answer must be no. But we do have a thriving network of community gardens, city farms, allotments, and community run growing projects all which constitute urban food growing initiatives... (in Viljoen et.al 2005 pg. 83)."

Iles highlights a few of the challenges and strengths for urban agriculture regarding its unique character to geography. The UK has a growing network of urban agriculture that fits the social, political, and economic context of the United Kingdom, though is not nearly as robust as the Cuban system. Is one city's urban agriculture comparable to another's urban gardens or network of allotments? Does a city farm in the UK compare to a small scale farm in the provision of food and increased ecosystem services? Given the spatial and community differences between New York City and San Francisco, do the physical and productive forms of UA resemble one another or use similar vocabulary to describe UA projects? Differences in the definition and categories for scales of production and spatial form can be a challenge for closing gaps in research and the successful implementation of urban agriculture (Napawan, 2014. Lin, et.al, 2015; Surls, 2014)

Typologies can add clarity and depth to the definition of UA for the purpose of providing focused research, thorough inventories of food production in cities, and providing frameworks for future development.

The RUAF Foundation (Resource Centres on Urban Agriculture and Food Security) developed the following dimensions for developing UA typologies that are specific to a particular city or region.

- **Types of people involved-** urban poor supplementing food income, eco-conscious middle and wealthier citizens, teachers and educators providing outreach
- **Types of Location-** intra urban, vacant or abandoned land, peri-urban, private homestead land, public land, schools and hospitals,
- **Products Grown-** grains, roots, vegetables, fruits, meats and fish, ornamental plants, medicinals
- **Economic Activities-** agriculture and food products, processing wastes, education and value added enterprises
- **Product Destination/ Market Orientation-** self consumption, selling at farm stands, selling to market or local shops, selling to supermarkets, used for barter/ informal economy
- **Scales of Production and Technology Used-** micro scale, home garden or community garden plot, medium sized school or hospital gardens, large scale farm operations.

The thorough APA advisory report authored by Hodgson et.al. (2011) also provides insightful dimensions for developing typologies for UA, but omits an important category of understanding the people who are involved in urban food production activities. The list of dimensions and brief definition is provided below for comparison, but the dimensions provided by the RUAF provide a more explicit criteria.

- **Purpose-** production of plants or animals for personal consumption or use, educational or demonstration purposes, neighborhood revitalization or economic development.
- **Location-** located within urban, suburban, or peri-urban areas, on underutilized private or public land, or on building sites in developed residential, commercial, or industrial areas.
- **Size and Scale-** on large or small, contiguous or segmented land, rooftops, balconies, utility

- rights of way.
- **Production Techniques-** in soil or raised bed cultivation, hoop house or greenhouse, hydroponics, and aquaponics,
- **End Products-** production of plants or animals for consumption or ornamental use as well as the production of key UA inputs such as compost.

The above framework for developing UA typologies is directly related to the definition of UA for this project, from Chapter 1;

Urban agriculture (UA) is the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products. The first characteristic is that it is an integrated part of the urban economic, social, and ecological system from city center to the urban fringe and includes a variety of production intensities from household subsistence, to commercial agriculture and can include a range of goals for addressing social and environmental justice in urban areas. Second, it is complementary to rural agriculture in that urban agriculture is a model for increasing efficiencies for provisioning food while reducing environmental degradation and removing socio-economic barriers to healthy and nutritious food.

Two distinct but inter-related categories begin to emerge for developing typologies when considering the dimensions for UA by the RUAFA and the pivotal research and texts (Lester, 2006; Van Veenhuizen, 2006; Lawson, 2005; Viljoen et. al., 2005; Quon, 1999; Mendes et.al., 2008; in Napawan 2014) (Waldheim, 2010; Imbert, 2010; Hodgson, et.al., 2011; Surls et.al., 2014) and the definition of UA for this project. The APA report authored by Hodgson et.al (2011) may have omitted an important dimension for the development of typologies, but provides a thorough investigation and description of the typologies for urban food production in the United States and is shown in table A. Napawan (2014) builds on Hodgson et.al. (2011) that developed a typology of UA for identifying the shortcomings of local initiatives to encourage UA projects in San Francisco, CA. Where Hodgson et.al. (2011) develop categories of commercial or noncommercial, Napawan's (2014) work developed the following two categories;

1. **Programming** of the UA project- expresses whether the production of food is for sale at market (commercial) or for subsistence or to serve other community interests beyond food production (non-commercial) or any combination of the two including processing, distribution, or educational activities (hybrid).
2. **Spatial scale/** form of the UA project- the analysis solely of the physical form removed from the program considerations, location (urban vs. peri urban vs. rooftop), and landscape elements like accessory structures and materials (orchards, tool sheds, on site processing)

Napawan's (2014) study aims at finding gaps in city policies that fail to recognize the full range possibilities for UA projects in San Francisco, CA by separating the programming categories are removed from the spatial opportunities. This study built on the typologies developed by Hodgson et.al. (2011), TABLE 1 and compared those criteria and types of UA against the typologies developed by the SFUAA (San Francisco Urban Agriculture Alliance). A list of spatial and programmatic typologies developed specific to the goals of the study and to UA activities in San Francisco are shown in TABLE 2. After a full analysis (see Napawan, 2014) the study found that the full range of programmatic opportunities like growing food for demonstration and education are neglected.

The typologies provided by the APA and the complete study by Napawan (2014) provide a clear and thorough connection between the spatial and programmatic typologies. Typologies that enhance the definition of UA are important for the continued applicability of research and the successful implementation of research on UA projects. The development of typologies also have important

TYPLOGIES	Definition
Non- Commercial	
Private Garden	Private food gardens associated with the residence; End products typically used for personal consumption
Commnity Garden	Small to medium scale food production, but can include ornamental and medicinal plants on individually managed plots; garden usually managed collectively; activities for personal use, education, or sold off site; goals of garden are important
Institutional Garden	Small to large scale food-producing gardens; public or private institution; can include medicinals, ornamentals, & orchards; private or public institutional property (school, hospital, faith-based organization, workplace); gardened by an organization or business, typically used for educational, therapeutic and community service purposes- ex. include (nutrition education, environmental stewardship, and community ministry); end products are typically used for donation or consumption, but may also be sold on- or off-site at a stand, market, orstore to financially support the garden's specific activities.
Demonstration Garden	Small food-producing garden located on private property (school, hospital, faith-based organization, workplace) or public property (park, school, and other civic space) for public demonstration purposes only; gardened by a local government agency; community organization, or business; products are typically donated to local organizations and food banks.
Edible Landscape	food-producing plants in the design of private and public outdoor spaces; attended to by an individual or business; products are typically used for consumption
Guerilla Gardening	Unauthorized appropriation and cultivation of food-producing or ornamental plants on untended, abandoned, or vacant private or public land by an individual or group; products are typically used for neighborhood revitalization purposes.
Hobby bee- keeping	Small-scale keeping of honeybees for personal use; Beehives can be co-located with gardens or non-garden uses, on underutilized spaces (rooftops) in residential, mixed-use, or other public land areas; products are typically used forpersonal consumption, education, or donation
Hobby chicken keeping	Small-scale keeping of chickens for personal or commercial use; Poultry keeping can be co-located with other agriculture and non-agriculture uses; products are typically used for personal consumption, education, or sale.
Commercial	
Market Farm	Small- to medium-scale production of food-producing or ornamental plants, bees, fish,poultry, or small farm animals; located on public or private property; designed and managed for commercial purposes using a variety of growing techniques including in-soil,container, hydroponic, and aquaponic growing systems; products are typically soldon- or off-site at a stand, market, or store.
Urban Farm	Typically larger than market gardens and include larger scale production of food-producing or ornamental plants, bees, fish, poultry, or small to medium farm animals; commercial purposes using a variety of horizontal and vertical growing techniques including in-soil, container, hydroponic, and aquaponic growing systems; products are typically soldon- or off-site at a stand, market, or store. If large enough, urban farms may adopt the community-supported agriculture (CSA) distribution model, through which consumers of the farm's produce over the growing season also share in its risks.
Peri-Urban Farm	Practiced outside or on the fringes of metropolitan areas, often on agricultural land facing some threat of future development; Includes larger scale production of food-producing or ornamental plants, bees, fish, poultry, or small to large farm animals for commercial purposes using a variety of growing techniques; Usually employ organic techniques, are managed as agricultural businesses, and often employ the CSA model; Farm's production typically marketed and distributed in the nearby metropolitan area.
Bee-keeping	Medium- to large-scale keeping of honeybees for commercial use; Beehives can be co-located with other urban agriculture uses or other non-agriculture uses (ex.parks or rain gardens), on underutilized spaces in residential, commercial, mixed-use, or industrial areas; End products are typically used for sale

TABLE 1 Adapted from Hodgson et. al. (2011)

implications for this project and the greater body of research on the challenges and barriers for urban agriculture.

This project specifically addresses that one way to reduce the challenges and barriers for urban agriculture is through research, education, and technical assistance that can be provided by UMass Amherst (Avoid the acronyms when feasible, like here) extension. This is the focus of subject 2 of this literature review, however an important implication from the development and discourse on UA typologies is important to this project overall. Two important academic articles address the perceptions by UC Davis extension staff and the role that those extension staff could play in providing assistance for strengthening urban agriculture projects. Surls, et.al. (2014) and Reynolds (2011) the

Spatial typologies	Programmatic typologies
1. Kitchen garden	1. Ornamental plant use
2. Allotment farming	2. Recreational gardening
3. Edible landscape	3. Demonstration/education
4. Small-scale farm	4. Gleaning/foraging
5. Large-scale farm	5. Personal consumption
6. Retail, distribution, and support sites	6. Subsistence
	7. Commercial market farming
	8. Retail and product distribution

TABLE 2 Source; Napawan, 2014

development of a clear definition and associated typologies were important for the research. Reynolds (2001) concluded that many respondents in the research did not have a clear understanding of UA noting what differences existed in urban or peri-urban and commercial vs. noncommercial activities, even when a definition and typology for UA was provided. A later study by Surls et.al, (2014) that utilized survey data of University of California Cooperative Extension (UCCE) and University of California Division of Agriculture and Natural Resources (UC ANR) excluded many UA activities based on the commercial vs. non-commercial programming discussed above; food production activities that did not distribute to the community, even school gardens or community gardens were omitted from the study. Reynolds, (2011)

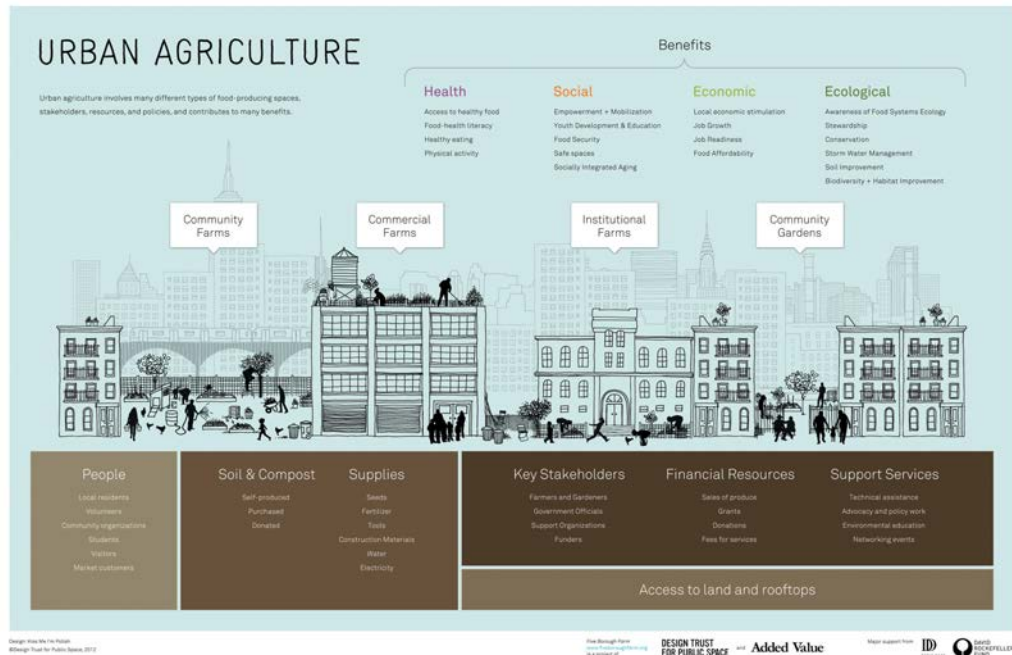
While the spatial and programmatic categories do not necessarily need to be separated for examination such as is the case with Napawan (2014), some studies such as Reynolds (2011), and Lin et.al. (2015) combine the spatial and program elements to develop applicable types of UA for study. However, in some cases typologies may create some confusion and fail to provide a clear connection between spatial form and programming and not fully crystalize a definition for UA. Lin, et al (2015) in their research of the quality and quantity of ecosystem services provided by urban agriculture, developed the following typologies:

- Allotment or Community Gardens.
- Private gardens
- Easement Gardens
- Roof-top Gardens
- Community Orchards

Lin et. al (2015) discuss the importance of different types of urban agriculture within a system which allows for a diverse set of vegetation structures to contribute to the edible landscape in a range of community types (Mclain, Poe, Hurley, Lecompte-Mastenbrook, & Emery, 2012). Bin. et.al (2015) acknowledge that many UA systems may fit into more than one category where both private and community gardens may exist as rooftop gardens and community orchards (defined as a landscape of tall trees) may exist within community gardens. It is clear that this study is intended to determine the possible ecosystem services provided by the above typologies, however it is difficult to differentiate between some of the types of UA provided.

In practice, New York City's Five Borough Farm Project (2012) developed a typology for the study and development of UA projects around New York City. This project developed by the Design Trust for Public Space identified four types of urban agriculture based on the particular opportunities across the New York City Metropolitan area and provides a matrix of spatial and program elements to describe each typology.

- Institutional Farms and Gardens; hospitals, churches, prisons, schools, public housing- primary mission not food production but have goals that urban agriculture supports
- Commercial Farms; maximize crop performance to achieve profitability, but share many



of the health and ecological goals of broader urban agriculture community

Five Borough Farm
Source; Five Borough Farm.org

- Community Gardens; 490 across the city, typically managed by local resident volunteers, 80% grow food
- Community Farms; communal growing spaces operated by a nonprofit organization, engages surrounding community in food production and provides social and educational programming

Imbert (2010) presents an alternative to the formal typologies discussed above. Three themes are presented that can direct the landscape architecture and planning professions to articulate a spatial vision for urban agriculture as a design strategy across the urban transect. Imbert (2010) writes that the three “examples are not intended to be a comprehensive list,” but identify historical precedents for contemporary trends in “integrating landscape architecture, agriculture, and urbanism (pg.259.” The three themes are palliative, recuperative, and projective.

The first theme, **palliative**, (meaning to *alleviate a problem* or in medical terms, *provide relief from symptoms and often without dealing with the underlying cause*) suggests that historically gardens and allotments were “an antidote to urbanization as well as a moral and economic stabilizer of modern society (pg.259).” Imbert (2010) cites German landscape architect Leberecht Migge who in the early 1900’s argued that “foodstuff is a tool for land reform and a counter to overcrowded urban conditions” and that he saw planting as an antidote to wasteful contemporary city with hectares of fallow streets and tenements (Imbert 2010 ; Haney 2007).” Connection to the soil via gardens and allotments became a contrast to the urban condition where in Denmark, allotments were designed as permanent landscape structures through a series of oval hedges as part of the open space system (Imbert, 2010).

Imbert (2010) refers to the second theme as **recuperative**, which transforms the experience of the city by turning vacant or blighted land into a site of public investment. An example of this is provided by Imbert (2010) in post war Amsterdam where small interstitial spaces were designed as playgrounds

to respond to local neighborhood conditions but modified the whole- hundreds of playgrounds where designed across the city that physically and morally repaired the fabric of the city. The lessons to be learned for urban agriculture: “the modesty of scale and means, the variety of permutations, the understanding of human activity, a systematic approach, and the ability for design to improve living conditions (pg 262).” The recuperative typology is used to address the visionary work of Continuous Productive Urban Landscape (CPULs) by editors Viljoen and Howe (2005) that builds on the Cuban urban agriculture model that evolved as a result of the collapse of Communism. CPUL’s posits that urban agriculture landscapes can restructure the form and function of the city through a systems approach by “linking inner city allotments to existing parks and the periphery.” She writes that “such a model is ecologically suitable, economically feasible, and socially redemptive (Imbert 2010).

The last theme on urban agriculture provided by Imbert is **projective**. This can be defined as landscape functions and more specifically “urban agriculture as a means to structure urban development (pg. 263).” Drawing on the work of landscape architect Michel Desvigne, the projective theme provides that “ the landscape not only performs an ecological role in terms of storm water management and biodiversity, but more importance creates a spatial framework for future urban development (263).” The projective is best illustrated by Imbert, writing that;

“Governors Island, agriculture practices provide a model for soil management and a strategy for phased development;

The visionary work for the reclamation of a Renault factory where allotments and fields of garden produce precede planting trees and architecture; The Lisiere, a response to French President Sarkozy’s 2009 call for transportation and ecological visions for Paris designed a landscape of planned indeterminacy that “hems suburbanization of the countryside and allows agriculture to reenter the urban (pg. 266)



Michel Desvigne Projective Ecology
Source; Imbert, 2010

This theme is completed by Imbert’s (2010) argument that here, agriculture presents a paradox where “rational layout, fast out-put, soil improvement, composting, and water management speak to a sustainable agriculture that is totally artificial, but triggers a connection to food, earth, and the rural landscape. (pg 266)”

The themes for UA presented by Imbert are less typological in nature, but to provide an alternative, if less comprehensible, synthesis of the dimensions of urban agriculture across time and space. These themes were intended to provide food for thought on visions for integrating UA activities as a green space system across the urban landscape linking blighted neighborhoods attempting to recuperate from disinvestment, to urban dwellers seek recreation and social connection in the network of 20’x20’ community gardens, to the range of small and large peri-urban farms. The formal typologies developed from spatial and programmatic categories fall short of providing a vision.

Urban and peri-urban agriculture is a broad subtopic within the overall study of urbanization and cities. Its inclusion for study and implementation in the urban fabric presents many challenges. Given the claims of social, environmental, and economic benefits, many challenges for implementation also exist including defining what UPA is and illustrating its physical and spatial form on the landscape to the challenges and barriers for viable implementation.

Conclusion

Two important themes were informed and reinforced by the research for the literature review (a) the continued need for defining urban and peri-urban agriculture and the development of typologies respective of the socio-economic climate and geographic location of the study (b) that among all of the social, economic, and environmental implications for UPA, Extension services can play a pivotal role in furthering the local and regional study of UPA while simultaneously strengthening the implementation of UPA systems through resource and educational assistance for urban communities and metropolitan regions.

Some studies utilize the formal typologies by such as those created by the APA (Hodgson, et.al., 2011) to develop a more illustrative understanding, but add that UPA should be viewed as a continuum across urban and peri-urban regions. It is here that the typologies for urban agriculture can be understood in spatial and programmatic terms and may be combined depending on the study. It is also the reason for providing an alternative and more abstract typological set provided by Imbert that allow for this continuum, or thinking of UPA as a multi-dimensional system, that operates at linked spatial and programmatic scales.

The development of typologies are important for developing clear definitions for UPA that can enhance academic research, but also help city officials and those interested in UA as a study of urban development, inventory and analyze the scope, scale, and goals of realized projects. This provides a stronger case for how and why University Extension may focus its attention on urban agriculture, less as a global phenomenon and more to understand and quantify the benefits provided by a local UPA system.

b. Urban Agriculture- A New Role for University Extension

The Salt, a news outlet that focuses on food production and consumption issues operating under National Public Radio (NPR) reported on the University of the District of Columbia's (UDC) research farm that serves as a resource for urban farms and farmers (Urban Farmers 2015). The director for UDC's land-grant programs, Sabine O'Hara said that "it's clear that urban settings, given how many people live there, still have an important role to play in food security and production (Urban Farmers, 2015).

Cuba, a national "case study" widely cited for its response to food insecurity caused by the fall of communism, developed an alternative agriculture system linking urban, peri-urban and rural agriculture (Altieri, et. al 1999; Diaz & Harris 2005, Koont 2008). Cuban government sectors like The Ministry of Agriculture structured itself as an agricultural extension service playing an important role in outreach, research, and development (Diaz and Harris 2005 CPULS; Koont 2008; Altieri 2008) for urban and peri-urban farming while advising citizens efforts of growing food. Harris and Diaz (2005) citing Novo and Murphy (2001) write that Cuba is the "world's first nationwide coordinated urban agriculture programme, integrating access to land, extension services, research and technology

development, new supply stores for small farmers, and new marketing schemes and selling points for urban producers (pg. 144).” Harris and Diaz (2005) emphasize the role that agricultural extension can play in the development of a new food system stating that agriculture in Havana, the Capital city of Cuba, “is backed by an extension service that would be the envy of most of the world (pg 140).” The Cuban national agriculture system developed out of a national crisis for food imports, is one rooted in the applied research and “learning by doing” model of extension services. This can be a framework for extension services in the United States.

In the United States, Cooperative Research and Extension is the national system through which the United States Department of Agriculture’s (USDA) National Institute of Food and Agriculture (NIFA) partners with Land Grant Universities to provide research based information to the public (USDA 2015; Reynolds, 2011). Traditionally, cooperative research and extension has been linked to promoting rural development through the sale, marketing, and distribution of agricultural products through a cooperative market system, and advancing knowledge for agriculture, the environment, human health, and well-being (USDA 2015). Cooperative Extension Service, supported by the USDA and NIFA, seeks to improve the quality of people’s lives by providing research-based knowledge to strengthen the social, economic and environmental well-being of families, communities and agriculture enterprises (USDA 2015). The Cooperative Extension System in the United States is operated through land grant colleges and universities and supported by NIFA and the USDA to bring practical information and knowledge to communities in six major areas: youth development, agriculture, leadership and development, natural resources, family and consumer sciences, and community and economic development (USDA 2015; NIFA; 2015). These categories for community outreach may also be addressed by many types of UA activities, but extension may overlook the range of social, environmental, and economic benefits provided by urban food production (Reynolds, 2011; Surls et.al., 2014; Reynolds & Cohen, 2014).

The historical precedent for growing food in cities was covered in Chapter 1, which was intended to convey the importance and prevalence of the activity for urban dwellers over time. In the United States, the USDA has been involved in many of these efforts including Victory Gardens of WWII that gave way to vacant lot community garden programs in Philadelphia in the 1960’s and Master Gardening Programs, which led to the USDA’s Urban Gardening Program in 1976 (Reynolds, 2011). The Urban Gardening Program after expanding to 23 cities with a dual focus on food production and nutrition for low income residents, faced its demise with federal budget cuts in 1994- to date no other USDA or Extension program is focused on urban agriculture (Reynolds, 2011).

The Cooperative Extension System (CES) is increasingly addressing the research and practical knowledge needs for improving cities at large and the lives of urban dwelling residents (youth development, agriculture, leadership and development, natural resources, family and consumer sciences, and community and economic development) (Oberholtzer et. al 2014; Reynolds 2011; Surls 2014; USDA 2015). Extension programs and the types of outreach they provide must change to support the needs of the public it serves, especially as urban and suburban development continues (Harms, Presley, Hettiarachchi &Thien 2013). Considering the increasing role that University Extension Services have in urban and suburban communities for; addressing those six major areas of research, applied knowledge, and programming by NIFA and the USDA; delivering research based education to the public (Reynolds, 2011); and the increasing diversity and operators in UA, University or Cooperative Extension can focus on the resource needs and technical assistance for UPA.

NIFA’s Cooperative Extension System partner in Massachusetts is the University of Massachusetts (UMASS), and across most states and land grant academic institutions is referred to as “University

Extension” with the name of the institution first such as; “UMASS Extension,” or informally as “extension.” This project uses “extension” or “university extension” interchangeably to describe CES broadly and UMASS NIFA’s the CES partner in Massachusetts. This project posits that UMASS Extension, operating under the universities’ Center for Agriculture, Food, and the Environment could renew and revive, the role of the Waltham Field Station to help bolster an urban and peri-urban food network in the Boston metropolitan area through research, education, and technical assistance. This renewed, revived role suggests substantial changes in the types of research conducted by NIFA and University Extension, the locations where this research is done, and how the new knowledge produced by the research can be disseminated to the new types of agriculture in urban and peri-urban areas.

The continued growth and claims made for the benefits of UPA are equaled in the challenges and barriers for an urban agriculture system and knowledge gaps in the research (Pearson et. al. 2010; Reynolds, 2011; Oberholtzer et.al. 2014; Surls et. al. 2014). These challenges include institutional barriers such as zoning and building regulations, inaccessibility to capital and credit, land tenure, lack of infrastructure for marketing and food processing, environmental contamination, and limited access to water to name a few (Reynolds 2011; Oberholtzer et. al. 2014). Maintaining social equity across race, class, and cultural divides as well as access to land in the context of contamination and land tenure are also identified in the literature as common barriers (Golden 2012). Cohen and Reynolds (2014) connect these barriers or challenges to the type of urban garden project by categorizing what types of “material” (land, soil, seed) and “non-material” (policy support, funding, technical assistance) resources and how to allocate them in order to make an UPA project successful.

One reoccurring theme that emerges from the research on UPA is a broad call for overcoming the challenges and barriers for UA (Reynolds, 2011) from policy measures, food awareness, and increasing support and extension services (Reynolds, 2011; Brown & Carter, 2003; Kaufman & Bailkey, 2000; Smit et al. 1996). Several decades of research and writing about the benefits of UPA have led researchers to address some of these challenges through Extension Services (Oberholtzer et. al. 2014; Cohen & Reynolds, 2014; Reynolds, 2011; Surls, et.al. 2014; Hendrickson 2014). Pearson, Pearson, and Pearson (2010) developed 5 priorities for future research on UPA. Though many of these priorities are relevant to this project, one such priority titled Information is particularly salient. Their research determined that the informational needs in developed cities relate to supply chains and securing resources. In this context they conclude that agribusiness industry, consultants, and government departments provide information and knowledge for rural farmers, but they ask- “Who will take responsibility for urban communities (Pearson, L. et al. 2010)?”

Citing decades of research, Reynolds (2011) developed a brief list of suggestions for expanding extension in an effort to overcome the challenges for UA. These suggestions include:

- Integration of urban food-system topics within research and extension programs (Brown & Carter, 2003; Feenstra et al., 1999);
- A return of extension to urban areas (Brown & Carter, 2003; Feenstra et al., 1999);
- applied ecological and agronomic research for urban and culturally diverse settings (Brown & Carter, 2003; Feenstra et al., 1999; Schertenleib, Forster, & Belevi, 2002);
- Community-based leadership development for UA and community food security (Brown & Carter, 2003);
- Education and demonstrations related to the environmental- and public-health risks of soil contamination (Brown & Carter, 2003; Drescher, 2002); and
- Facilitation of information exchange between regions (Smit et al., 1996).

Much of the literature addresses the broad challenges for UPA and suggests that some of these challenges can be met by expanding Extension Services, but little research exists on if Extension Services are the proper agency and if urban agriculture research is actually needed. Out of the vast amount of research and writing surrounding the broad social, environmental, and economic implications for UPA across the globe, 6 peer reviewed journal articles and one report by the University of Missouri Extension provided insight and research on the role extension services can play in strengthening UPA. Of the few themes that emerged from this research, two stand out; (a) the continued need for defining what urban and peri-urban agriculture is respective of the context and groups involved for the benefit of extension and research, (b) that among all of the social, economic, and environmental implications for UPA, the challenges of social justice and equity are tightly connected to food production and accessibility and that extension can and should play a role in addressing these inequities.

Reynolds (2011) found that UC ANR Extension staff had a lack of clarity regarding the term urban agriculture and that many extension staff distinguished their clientele as commercial or non-commercial, not urban or non-urban, leading to limited support by extension for UA. Despite this, Surls (2014) research and survey of UC ANR staff found that respondents overwhelmingly considered UA relevant to the mission of extension and were likely to develop or adapt programs and resources. Furthermore, Surls (2014) found in her survey that UC ANR had provided support, advice, and technical assistance or had served as a partner on a UA project. This leads to a conclusive point that urban agriculture is a broad term and to increase the educational and technical support from extension, it should be defined more clearly and rigorously to help understand the scope, current activities, and needs within UPA's urban or regional context (Reynolds, 2011; Hendrickson & Porth 2012 Surls, 2014).

Oberholtzer (2014), citing Reynolds (2011) and Surls et al. (2014) writes that land grant universities' and their extension programs are allocating resources for UA (Reynolds, 2011; Surls et al, 2014), but there is a dearth of research and literature regarding UA to rely on (Oberholtzer et al., 2014). This project assumes Oberholtzer (2014) is attempting to convey that there is little research on the role extension can have in supporting an urban agriculture system or narrowing the knowledge gaps given the context of her research, as there are vast amounts of peer reviewed research, journal articles, and seminal books on the broad topic of UPA over time and geographies.

Reynolds (2011), provides a thorough investigation on the links between Extension Services and UPA by; (a) assessing the types of urban agriculture in the study area; (b) exploring UA operators' need for technical assistance; and (c) assess county and statewide Extension staff members' understanding of and interest in expanding technical assistance for UA. This research paper provided the framework for Surls et. al (2014) that reported on the preliminary findings and analyses of a needs assessment for UA and the relationship between the needs of practitioners in California and the potential support provided by the University of California Cooperative Extension (UCCE) which is part of UC's (University of California) Division of Agriculture and Natural Resources (UC ANR). This paper particularly addressed how UC ANR personnel are engaged with UA, and what would best serve urban farmers (Surls et al. 2014). Similarly, Oberholtzer et al. (2014) identified the risks and technical needs unique to UA via a national survey within the context of implications for Extension and other service providers. Cohen and Reynolds', (2014) research on the resource needs of a UA system determined that resource needs go beyond the material and financial needs discussed in the urban agriculture literature and that social and political support along with financial and technical resources are needed to ensure a just and sustainable urban agriculture system.

The limited research articles concluded in general that Extension Services can and should be part of the solution for reducing the challenges for UPA through research based information, educational materials and technical assistance (Reynolds, 2011; Surls, 2014; Oberholtzer, 2014, Cohen & Reynolds, 2014; Hendrickson & Porth, 2012). This research identified some key conclusions that many extension staff and programs address many of the same topics in rural areas such as youth development, nutrition education, and production and marketing for small diversified rural and peri-urban farms, there are opportunities to adapt those programs and methods for addressing both the barriers to UA and the benefits associated with strengthening a UPA system (Oberholtzer et al, 2014; Surls, 2014). Reynolds (2011) provides a list of existing and new program areas that can be addressed by extension;

- **market gardening** (i.e., crop planning for community food production and distribution);
- **urban livestock husbandry** (e.g., basic livestock and beekeeping skills);
- **soil testing**, including information about the importance of testing soils in urban areas, where to have tests done, how to interpret results, and how to minimize risks of contamination;
- **marketing**;
- **business management** for both commercial and noncommercial operations;
- **community development**, including networking, community relationships, intercultural relationships, and antiracism; and
- **educating non-farmers** about the importance of agriculture in urban areas

Technical assistance and resources associated with production costs (Oberholtzer et al. 2014) water and pest management, soil testing, and advice for school gardens (Surls et al., 2014) are important resources that could also be added to this list.

Nearly all of the research used for this project and the specific research for this literature review determines that beyond traditional types of technical resources, extension services can be a factor in alleviating social justice and food equity concerns (Surls, et al. 2014; Golden, 2012; Cohen & Reynolds, 2014; Reynolds, 2011). Equally important is that the technical resources and programs should be developed based on a needs assessment to reflect the spectrum of UA projects and practitioners (Surls et al. 2014; Reynold, 2011). Cohen and Reynolds (2014) research on UA activities in New York City determined that Cooperative Extension could provide more robust technical assistance through fostering networks among city and rural farmers and support and augment health, nutritional, and education programming. They developed three areas that technical assistance can;

- conduct program evaluations to document the extent urban agriculture is meeting the goals of the funder and city agencies
- help farms and gardens accomplish community development by providing resources for organizing, develop networks for city and rural farmers and facilitate partnerships, and;
- provide assistance for organizational capacity especially for people of color.

A co-learning, or participatory research approach begins to emerge for reducing barriers for social equity issues surrounding UPA. Due to discriminatory practices historically by the USDA (Reynolds, 2011) and extension agents being traditionally focused on the economic aspects of agriculture, relationships between UPA practitioners and extension staff will need to view farming through a social justice lens and base programs on collaborative methods (Surls, et al. 2014). Reynolds, (2011), writes that “USDA agencies, including Cooperative Extension, might learn effective strategies from UA operators who have actively worked to address issues of food justice and community empowerment through their programs (pg17).” The co-learning or participatory approach is reiterated by Surls et. al.

(2014) who writes that “research in which researchers and community organizations together develop research protocols, gather data, analyze it and draw out implications is rare; yet sorely needed for strengthening the theory, practices and policies about UA (pg 8). Furthermore, Surls et. al (2014) provides an eloquent summary for extension research for strengthening UPA:

In particular, comparative case studies that involve both researchers and community practitioners in design, data gathering and analysis, can begin to address some of the social justice challenges faced in UA settings. Beyond providing a source of accessible, science-based information for urban farmers and policy makers, UC ANR and similar institutions can play an important role in contributing to the growing body of knowledge on UA and its impacts on communities.

Conclusion

By embedding these ideas for addressing the challenges for UPA into the spatial makeup of existing and proposed green spaces across a region, and identifying the resource needs and challenges for bolstering a UPA system, Extension’s role for providing applied knowledge and educational and technical assistance becomes clear. Extension may strengthen its mission by providing a needs assessment case for itself in a “budget cut” political climate, to develop a regional or national program for UPA similar to the successful Cuban model. Not only will University or Cooperative Extension provide the technical and educational resources and programs developed by Reynolds (2011) shown below, but also increase the capacity and body of research for “learning by doing” and providing quantitative and applied study of the real benefits and short-comings of UPA. In this way, University Extension services become indispensable to addressing the spectrum of challenges associated with urbanization and food access.

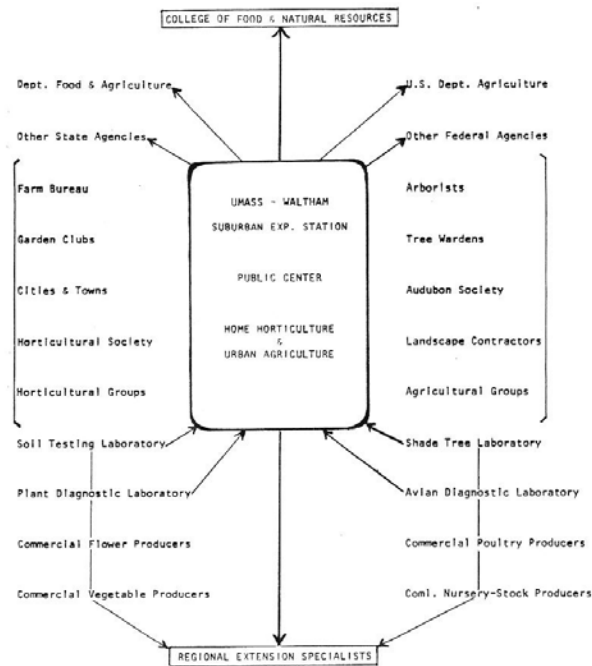
- **market gardening** (i.e., crop planning for community food production and distribution);
- **urban livestock husbandry** (e.g., basic livestock and beekeeping skills);
- **soil testing**, including information about the importance of testing soils in urban areas, where to have tests done, how to interpret results, and how to minimize risks of contamination;
- **marketing**;
- **business management** for both commercial and noncommercial operations;
- **community development**, including networking, community relationships, intercultural relationships, and antiracism; and
- **educating non-farmers**

The intent of this literature review is to narrow the broad topic of urban and peri-urban agriculture as a response to the social and environmental consequences of feeding a more populated and urban world. There are many opportunities for continued research on this global phenomena, but the opportunities for this masters project involve a proposal for reinvestment in University of Massachusetts Amherst Waltham Experiment Station. This literature review was developed in order to address this opportunity and provides a specific scope for the site analysis and proposed master plan.

3. Project Description/ Site Analysis

a. Introduction

The Waltham Experiment Station located in Waltham, Massachusetts is a property of the University of Massachusetts Amherst. The Station’s future is under review by the University Of Massachusetts Amherst College of Natural Sciences, the unit with administrative responsibility for the Waltham Experiment Station. The idea for this project was launched because of the state of physical disrepair of this historically renowned, but currently obsolete and under underutilized University of Massachusetts Extension facility. This site and the University of Massachusetts system at large is physically and systematically well suited for aligning itself with the trends for urban and peri-urban agriculture. In this way, this project seeks to redesign the Waltham Experiment Station as a center for UMASS Extension to the study, research, and carry out the “learn by doing” applied research approach of extension services to address the challenges and barriers for UPA.



University of Massachusetts Extension Organization Chart (Faddoul, 1984)

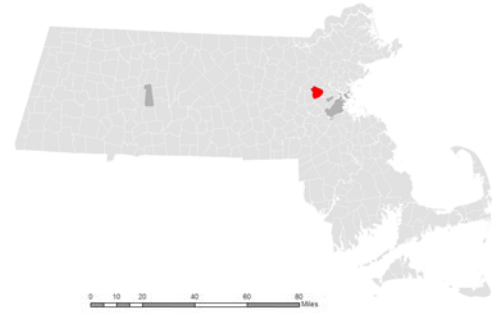
The Waltham Experiment Station was established in 1923 to conduct agricultural research and offer outreach programs and resources to citizens, professionals, and commodity groups in the Boston metropolitan area. For several decades the Station was very active with field and greenhouse research and outreach programs. More recently most of the University uses have ceased and the Station is now significantly underused. The lack of use by the University is related to a serious decline in the condition of most of the buildings at the Station. However, this underused site presents important opportunities for a new paradigm in food production in cities that can address socio-economic and environmental issues beyond the basic provisions for food.

The idea for this master’s project developed as the former University Of Massachusetts Office Of Outreach began exploring the existing uses, and potential of the Waltham Experiment Station to be redeveloped. This Chapter will provide a site analysis in order to fully understand the potential of this 56 acre site located in Waltham, Massachusetts.

b. City of Waltham

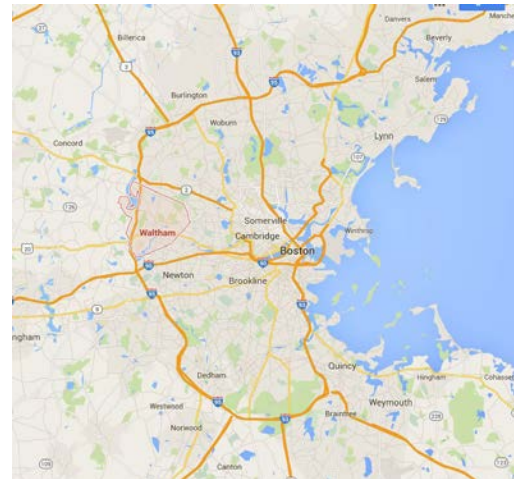
The Waltham Experiment Station is located at 240 Beaver Street, Waltham Massachusetts. The Experiment Station has been located here since 1916 and has been named a number of ways; Waltham Market Garden Field Station (1925), Waltham Field Station (1930), Suburban Waltham Experiment Station (1961) UMASS Waltham Center (Current). This project uses the Waltham Experiment station name - but first it’s important to understand the context of the city in which it is located.

The City of Waltham is bordered by Lexington to the north, Belmont and Watertown to the east, Lincoln and Weston to the west, and Newton to the South. Waltham is approximately 75 miles east of UMass Amherst, 33 miles east of Worcester, and 10 miles west of Boston. Waltham is a densely populated suburb approximately 10 miles west of downtown Boston. Waltham's location has historically been a defining factor in its development. The Charles River, which traverses Waltham, has been a dominant natural resource with important implications for the development of Waltham, whereas Waltham's physical location within the region relative to the man-made transportation network has also been a critical determinant of Waltham's development patterns.



Locus Map 1: Amherst and Boston shown in dark gray, Waltham in red

Waltham has developed over the past 150 years from a farming community to a manufacturing center, and more recently to a “high-tech” community. This shift in development has yielded a very diverse housing stock allowing the increase in population of multi-ethnic immigrants from the Caribbean, Central America, and Southeast Asia (City of Waltham 2015). The success of “high-tech” development in Waltham can be attributed in part to the commercial corridor of office parks and transportation access that exists along Route 128/ Interstate 95 corridor. The City Center of Waltham along Moody, Main, and River Streets is also a corridor of business and commerce and each of these creates a diverse business market in Waltham (City of Waltham 2015).



Locus Map 2: Waltham outlined in red

The major transportation connections in Waltham are Interstate 95/Route 128 and state highway Route 20 which intersect in western Waltham. The Massachusetts Turnpike and state Route 2 are easily accessible to the south and north, respectively. The City of Waltham is also serviced by the MBTA Fitchburg commuter rail line that connects to Boston's North Station, with a station in Waltham Center and at Brandeis University. The City is developing “healthy transportation networks” and seeking recognition as a “Bicycle Friendly Community.” Waltham is developing shared bike facilities and dedicated bike lanes and working with Massachusetts Department of Conservation and Recreation on developing the Wayside Trail, a proposed multi-use trail that utilizes the former railroad right of way and will link Waltham, MA to Berlin, MA. This proposed trail directly abuts the Waltham Experiment Station.

The Route 128/Interstate 95 corridor is the main economic and technological/business center of Waltham. Due to the many major transportation links, Waltham is business and commercial-supportive, having the second largest office market in Massachusetts, second only to Boston. Waltham has experienced a dramatic increase in land value over the last 5 years finding itself within the wave of Boston metropolitan development. The city center is currently experiencing town center redevelopment with an aggressive revitalization program in progress.

The Waltham Community Development Plan identified the city of Waltham as the third largest

employment center in the eastern Massachusetts region and is third in property tax values behind Boston and Cambridge. Commercial property values in Waltham have experienced the greatest value increase over all commercial, industrial, and personal property (CIP) in the last two decades. Current tax valuation of commercial property is 1,895 million dollars. According to the Community Development Plan, commercial property value and commercial land is forecasted to continue growing. Waltham has the potential to see an additional 1.6 million square feet of commercial office space and an increase of 4,700 new jobs by 2020 (Waltham Community Development Plan p. 141).

Waltham currently has approximately 60,000 residents in an area of 13.6 square miles, with a density of approximately 4,400 people per square mile/ 6.8 people/acre. According to the 2015-2022 City of Waltham Open Space Plan, more recreational and open spaces are needed in all areas of the city in light of the dense settlement pattern (2015). This has important implications for the preservation of the Waltham Experiment Station in light of the importance of UPA, development trends in Waltham, and the preservation of one of the last remaining agrarian landscapes of Waltham.

b1. City of Waltham Community Development and the Waltham Experiment Station

The City of Waltham Community Development Plan was adopted by City Council in June 2007. It analyzes the city's natural resources and open space, housing, economic development, transportation, and land use within the context of the Boston Metropolitan area. The Community Development Plan outlines a series of goals and a "to do list" for each topic that provides thorough insight to potential growth and development in Waltham.

The Waltham Experiment Station was explicitly identified in the Community Development Plan in conjunction with the city's goals for natural resources and open space protection. The City of Waltham Community Development report identified a few tasks and objectives for the Waltham Experiment Station site at the regional and city wide level as an important parcel of land that could be part of a system of hiking/biking trails, part of the Waltham Western Greenway, and potential conservation land. Selected Community Development Plan goals and tasks that relate specifically to the Experiment Station include;

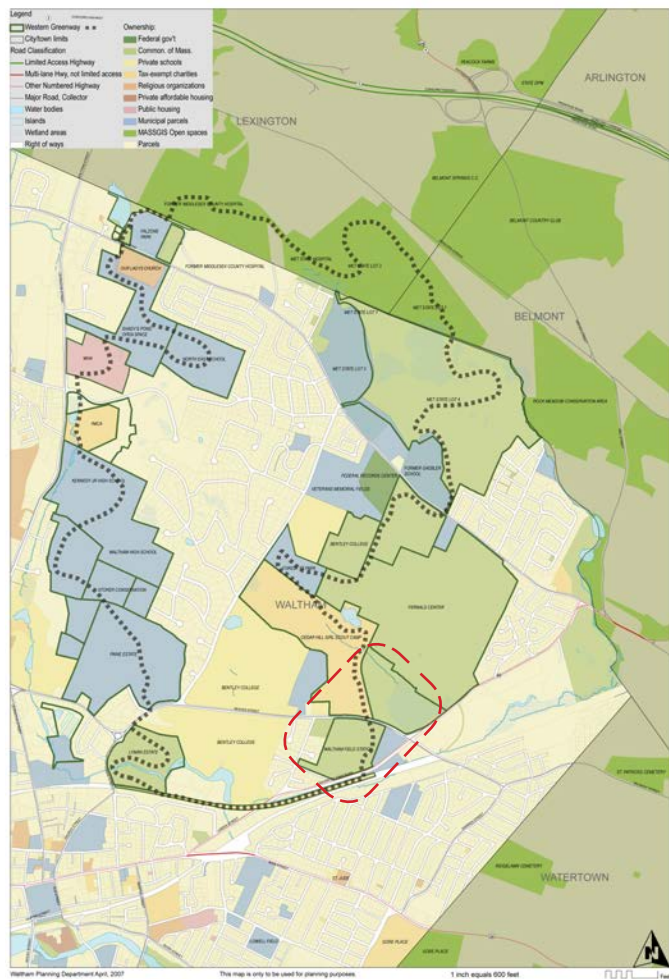
- *Explore creating a series of attractive corridors/trails/paths linking parks, open space, residential neighborhoods, downtown Waltham, and gateways to the city. This can be started by acquiring or securing permanent public access to several key open space parcels, including the Lincoln Woods property, the Stigmatine Espousal Center, the **University of Massachusetts Field Station**, and the Berry Farm site amongst others. (The City Of Waltham Community Development Plan pg. 6)*
- *The need for conservation is another major concern in the community. The Robert Treat Paine Estate is the City's only official conservation area. With the changing landscape character of Waltham and the pressures of traffic and development, there has been an increased interest in preservation of land and conservation areas. The City should seek opportunities to acquire conservation land including wetland areas adjacent to Prospect Hill Park, near Metropolitan State Hospital Site, and the **University of Massachusetts Agricultural Station**. (The City Of Waltham Community Development Plan pg. 50)*
- *Other than the holdings cited above, the City of Waltham does not have much vacant land that could be used for recreation or conservation purposes in the future. The only exceptions are two parcels off Beaver Street and Forest Street. These two holdings, called the "Forest Street Park" (15 acres) and "Waltham Woods" (12 acres) are not protected and are under the jurisdiction of the Parks and Recreation Department. However, the City plans to keep them as open space available for the*

public. (The City Of Waltham Community Development Plan pg. 38)

- The proposed Central Massachusetts Bike Trail (Wayside Rail Trail) would be approximately a 23-mile trail on the abandoned railroad right-of-way running from Belmont through Waltham to Hudson and beyond to Clinton, roughly paralleling Route 20. It could connect with the Carlisle-Sudbury trail and would be the major east-west route in a regional bikeway system. The Metropolitan Area Planning Council has prepared and officially adopted the Regional Bikeway Plan (1997) that provides a regional context for all bicycle planning efforts in the 101 cities and towns of the MAPC region. The Central Massachusetts Branch is listed as a regional bikeway project that needs further analysis and support from all the communities that would be involved in its implementation. The MAPC Plan has not been officially adopted, but it contains information that will be incorporated into a more comprehensive plan during the coming year. (The City Of Waltham Community Development Plan pg. 52)

City reports including the Community Development Plan (2007) and the Open Space Plan (2015-2022) have expressed interest in acquiring and preserving the Waltham Experiment Station (if the University relinquishes its interest in the property and considering its current physical deterioration) to be part of Waltham’s recreation and open space plan. The Experiment Station is immediately bordered by several major land uses and institutions including: Bentley College immediately West on Beaver Street, the former Fernald School and the Girl Scouts of Massachusetts to the north, and the Wayside Trail to the South. The 189 acre tract of land formerly the Fernald School, is the largest tract of open space within the entire Route 128 corridor encircling the metropolitan Boston area and had recently been acquired by the City (City of Waltham, 2015). The Waltham Experiment Station, among these and other public and private open spaces now collectively form a network of green and open spaced called the Western Greenway.

The Western Greenway is a proposed, six mile corridor of land that begins in Belmont and Lexington and terminates in Waltham at the Extension office location. The Western Greenway will be a network of protected land that connects an 87 acre Massachusetts Audubon Society Sanctuary, Rock Meadow (Belmont Conservation Land), Beaver Brook Conservation Area, 240 acres of the former Massachusetts State Hospital land, a proposed link through the Fernald School, Waltham Woods, and a proposed link through the Waltham Experiment Station property. The Greenway trail will then follow Beaver Brook west along the active and inactive rail



The Western Greenway
Source; Waltham Planning Dept.

lines, then turn north creating a hiking loop through historic estates and conservation land through Waltham, Belmont, and Lexington. The proposed 23 mile Wayside Rail multi-use trail adjacent to the Waltham Experiment Station provides is part of the connectivity to and within the Western Greenway.

In summary, the City of Waltham has an ambitious vision for its future that acknowledges a balance between conservation of natural resources and open and green space habitats and development. The Waltham Experiment Station property is situated to complement, or directly support these ecosystem goals by providing trail and bicycle access within the Western Greenway, while increasing ecosystem services through food production and education via UMA extension programs. These programs can not only provide ecosystem benefits for Waltham, but across the metropolitan Boston Region.

C. Waltham Experiment Station Property Description

The Waltham Experiment Station is a total of 58 acres of land shown on Plan 1. The site is divided by Beaver Street into two parcels. Parcel 2, the north Parcel, contains approximately 30 acres of land on the north side of Beaver Street. This parcel is bordered by the Fernald State School to the north, Girl Scouts of Massachusetts to the west, Beaver Street to the south, and Waverly Oaks Road to the east. Parcel 2 contains a wetland, meadow and succession forest vegetation that slopes uphill to a cluster of existing structures, including: a farmhouse, a 3 car garage, two barns, and a fertilizer shed. Access to Parcel 2 is provided via a gravel road 700 feet long from Beaver Street that follows the western property border, rising approximately 17 feet in elevation terminating at the farmhouse and fallen barn.

Parcel 1, currently the active “Main Parcel,” includes approximately 28 acres south of Beaver Street and bordered by the Cornelia Warren Ball Fields to the east, Waverly Oaks Road- Route 60 to the south and a residential neighborhood to the west. Access to Parcel 1 is provided by three gravel driveways that enter the site from Beaver Street. Two driveways provide access and parking along the east, west, and south side of the administration building and the other provides access along the eastern side of the Gray Workshop Building with parking on the south side of the building.

c1. Waltham Experiment Station History

The history of the Waltham Experiment Station is long and varied. Much of this writing is a synopsis of important and thorough writing that includes primary source documents and by those persuading change and reinvestment for urban agriculture in and around Waltham. The writing on the history of the station is adapted from the documents provided below:

- Faddoul, G.P. (1984). A Report on the Origin and Mission of a Statutory Agriculture Station at Waltham. <https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/Waltham%20Mission%20Statute.pdf>
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- Kricker, D. (2011). Agriculture along the Western Greenway. Waltham Land Trust Journal (Spring)
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- Kricker D. (2011). Waltham Field Station at the Turn of the Century. Waltham Land Trust Journal (Fall)
-
- Young, R. (1963). A Short History of the Waltham Field Station. (1963) Robert E. Young with text adapted from the writings of E.F. Guba. University of Massachusetts Archives

Until its incorporation as the Town of Waltham in 1738, most of its 550 inhabitants lived on farmsteads along the Trapelo Road and Beaver Street sections. The area around and including the future experiment station was known as Cedar Hill and has been farmed since 1770. The land was

purchased in 1854 by the prominent Warren family and operated as a successful dairy and field operation on 200 acres by the philanthropist Cornelia Warren at a time when much of the land in Waltham was used for farming. Farmland Waltham was transitioning from subsistence farming to a market garden economy from the mid to late 1800's in which farmers sold their products such as; corn, barley, hay, butter, vegetables, seasonal fruit, milk, pork, and beef to the expanding Boston markets. Industrialization and modernization beginning in the early 20th century marked a new era where industry and housing outcompeted agriculture land uses. The construction of Route 128/ I-95, now a highly developed commerce and transportation corridor, cleared the vast network of pig farms, the last sale occurring in 1985 to become a corporate center marking the end of Waltham's agriculture history.

The work of Cornelia Warren didn't end with a successful dairy farm and pasture. Beyond the family wealth and prominence, Cornelia Warren was also dedicated to education and charitable causes and upon her death, instructed the trustees of her will to partition the Cedar Hill Estate and bequest the land to institutions which would preserve the land for public education and enjoyment. She deceased in 1922.

In 1916, the Boston Market Gardeners Association petitioned the State Legislature for an "extension" of the Massachusetts Agricultural College (UMASS Amherst) to service the needs of market gardeners in eastern Massachusetts. The site for the extension facility was originally located in Lexington, MA and in 1922 an office, laboratory, and greenhouse and been completed at the Lexington location and under control of the Massachusetts Agricultural College (UMASS Amherst) Department of Botany and Plant Pathology.

Warren's death and execution of her will provided parcels for educational use in Waltham, leading the College and the Boston Market Gardeners Association to request \$25,000 from the state legislature in 1924. This funding was approved and by 1925 an office building and a greenhouse were constructed and the site named the Waltham Market Garden Field Station. Between 1925 and 1946, the "Field Station" continued to expand the existing building and greenhouses, areas of study to include floriculture, entomology, horticulture and nursery trade, the name changed to Waltham Field Station (1930) (also became a department in the Massachusetts Agricultural College Experiment Station), though much of this work was of a service or of "extension nature." Demands for service increased and the Poultry Association was asking for a diagnostic laboratory by 1947. An appropriation of \$275,000 was made for the construction of a new building and \$15,000 for a fence as new home construction and increasing population caused pilfering of crops to become an issue.

Famous among the new varieties of vegetables developed at the center was the Waltham Butternut Squash which won an All-America Award as a crook-free crop of great uniformity, high yields, good storage, and flavor. Over the years the name has changed from Waltham Market Garden Field Station (1925), Waltham Field Station (1930), Suburban Waltham Experiment Station (1961) UMASS Waltham Center (Current), but the mission has remained constant as an Extension Facility conducting research and providing educational training and skill development for both the public and professional trades.

UMass Extension's mission at Waltham provided workshops in pesticide training, weed identification, safety for arborists, turf management, wetlands protection issues and regional chapters of horticulture and green industry trades have held meetings and exhibits throughout the early 1990's. Agriculture research and academic uses became consolidated at the UMA campus beginning in the mid-1980s and into the 1990's as Waltham's 350 year agricultural tradition became nearly extinct.

A new agriculture paradigm for growing food in cities is embodied in the current UPA activities occurring at the site. The Waltham Fields Community Farm (WFCF) a CSA that sells farm share to approximately 400 shareholders is the predominant user occupying 8 acres with the desire to expand. Green Rows of Waltham is a community garden typified by standard size plots that individual users lease. These and the other site users and researchers are part of a new interest in UPA for increasing food production in cities, but also for the cultural and environmental benefits provided by growing food close to its point of consumption. The historical agrarian and extension service narrative of the site that has given way to the current uses are important considerations for including and expanding these activities regarding the proposed master plan of the Waltham Experiment Station. UPA activities and the provision of urban ecosystem services can be increased by providing a more robust presence by UMA Extension for researching and studying the benefits of and challenges for urban food production. For this reason, a new vision for the Waltham Experiment Station is necessary.

c2. Waltham Experiment Station Existing Conditions and Development Potential

The Waltham Experiment Station includes 20 structures, 14 on Parcel 1 and 6 on Parcel 2. This portion of the report is summarized from complete report and assessment of the environmental, landscape, and building conditions submitted to the University in January 2010 titled; Waltham Experiment Station: Study of Existing Conditions, Development Potential, and Alternative Future Development Options and can be found at; <https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/walthamreport2010edit.pdf>

Parcel 1- "The South Parcel:"

Parcel 1, is located south of Beaver Street is largely a flat, agricultural field with minimal grade change except at the south-eastern edge of the property. Approximately 80% of parcel 1 is open field/mown lawn/former agricultural fields and the remaining 20% of the land is tree-covered. The tree cover is a mix of deciduous oak and maple trees that follow the east, south, and west property borders providing a buffer with the adjacent residential properties. A large stand of evergreen hemlock trees is present south of the Corn Laboratory along the east property border. Parcel 1 also has several significant planted specimen trees near the Administration and Gray Workshop buildings. The most significant specimen planting is a 60' tall Dawn Redwood tree (*Metasequoia glyptostroboides*).

The existing structures on Parcel 1 include; Administration Building, Gray Workshop Building with 4 attached greenhouses, a Boiler Building that serves as the heat source, the Corn Laboratory with 2 attached greenhouses, and hoop-style greenhouses. The Administration Building, Gray Workshop Building, and the Boiler house are the main structures currently in use.

The Administration Building was built in 1948 and has approximately 12,400 gross square feet. It includes a mix of office space, conference rooms, a lecture hall for approximately 160 people, and laboratory rooms. It was used in the past as a voting location for Waltham residents, but has been discontinued for such use since the 2008 election year.

The Gray Workshop Building is approximately 3,200 square feet that has limited office space on the upper floors and is primarily used as a workshop by the superintendent. The building is two stories and has a basement which functions as the workshop.

Currently, a Community Supported Agriculture (CSA) farm called Waltham Fields Community Farm and a community garden organization called Green Rows of Waltham (GROW) use approximately 9 acres of land combined. Some land is also occupied by UMASS-Boston researchers performing the Boston Area Climate Experiment (BACE) to characterize ecosystem responses to climate change



Plan 1: Existing Conditions

in old-field ecosystems and the Boston Area Gleaners (BAG) which salvages produce and surplus crops and delivers them to food pantries and shelters. Some of the organizations above also utilize building space in the Administration Building among others including, the Waltham Land Trust (WLT) who has been pivotal in developing the Western Greenway, UMASS 4-H Program, and recently Mass Farmers Markets (MFM) a non-profit that fosters and enhances farmers markets in Massachusetts to improve regional farms and access to local food. Mclean Hospital at one time in the recent past was experimenting with horticulture rehabilitation therapy and helped maintain a rose garden.

Soils on Parcel 1 range from very sandy loam, silty loam, and urban land. The soil types best suited

for agriculture use on the site are (106C and 106D) Narragansett- Hollis, (223B) Scio very fine sandy loam, and (251A and 251B) Haven Silt Loam. Very importantly, these soil types are designated as prime farmland soil and are also suitable for building sites. Most of Parcel 1 is suitable for agriculture uses and building construction according to the Middlesex County Soil Survey soil descriptions.

Limited development by the WFCF has been allowed in the form of temporary building and structures that can be moved. The concluding remarks from the Waltham Experiment report (2010) determined that the buildings are uninhabitable and all except for the administration building completed in 1950 are condemned. Parts of the Administration building are condemned and uninhabitable, but some office space is still being occupied. It will be demolished at an unknown date by the University. The site is understood as a blank slate aside from preserving prime agricultural soils and any significant trees. The significant trees are located near the administration building, two of which are important and can be preserved; 60' tall dawn redwood tree (*Metasequoia glyptostroboides*) and a red oak (*Quercus rubra*). In order to show the current state of disrepair photos x-x document a few of the buildings importance at one time.



	Soil Description	Depth to Seasonal High Water Table	Drainage Class	Capability Class
	106C Narragansett- Hollis	> 80 inches	well drained	*
	106D Narragansett- Hollis	> 80 inches	well drained	*
	223B Scio; very fine sandy loam	1-5.2ft	moderate	II*
	251A Haven Silt Loam	> 6 ft	moderate	I*
	251B Haven Silt Loam	> 6 ft	moderate	II*
	251D Hinckley loamy sand	> 6 ft	rapid	VII
	31A Swanset Muck	> 1 ft	moderate	V
	32A Freetown Muck	0- 3 ft. above surface	moderate	VII
	624B Haven: urban land			
	71B Ridgebury; fine sandy loam	0- 1.5 ft	slow/ moderate	VIII
	602 Urban land covered with impervious surface; on site investigations necessary excavated and filled land			N/A
	603 Urban Land; wet substratum excavated and filled land over alluvium/ marine deposits fillings typically required for building sites; soil tests recommended for gardens/ food production			N/A
	655 Udorthents; wet substratum soil properties vary greatly, can be suitable for building sites			N/A
	*			Represents prime farmland.

Map 3-Soils
Source; MASSGIS

The current occupants of office space in the administration building are listed below. According to the UMASS Office of Outreach, the rental of office and laboratory space in the Administration Building totaled 3,372 square feet.

Three tenants leased land at the Waltham Experiment Station, however the exact acreage used by the tenants was not available. A list of building and land tenants is provided (Source; Ahern & Hartzell, 2010).

BUILDING TENANTS

Name	Square Feet/Use	Annual Rent
Community Farms Outreach- (CFO)	500/Office space	\$4,200
Grow Tech	432 /Laboratory space	\$4,200
Farmers Market Federation of Massachusetts (FMFM)	384/Office space	\$4,200
Waltham Land Trust (WLT)	312/Office space	\$4,200
UMASS 4- H Program	1400/Office space	N/A
Total Leased Office Space	3,028 square feet	\$16,800

LAND TENANTS

Name	Annual Rent
Green Rows of Waltham (G.R.O.W.)	\$1,062
Community Farms Outreach (C.F.O.)	\$4,834

This is an important consideration when viewed against the cost of commercial office space for rent in Waltham. As discussed earlier, Waltham has the second highest cost of commercial space, second only to the City of Boston. The University can further the potential for other non-profit and educational collaboration by providing affordable office space for other organizations whose mission is educationally or social and environmental justice motivated aligning with the spirit and mission of the State University system and UMA Extension Services.

Parcel 2- The North Parcel:

Parcel 2 has a gently sloped terrain that rises approximately 17 feet from Beaver Street along the western half of the site. Parcel 2 includes a mix of evergreen and deciduous trees and shrubs along the west property line and entrance drive and an open field on the eastern side of the drive. This vegetation on the west creates a physical and visual buffer between the Girl Scouts of Massachusetts property and the Waltham Experiment Station. The open field begins at Beaver Street along the drive and continues north to the front of the farmhouse separating the wetland and mixed vegetation on the eastern half of the site. The eastern portion of Parcel 2 is mostly flat and is predominantly a wetland with wetland vegetation. Some fruit trees exist near the wetland.

The soil types on Parcel 2 range from very sandy loam, silty loam, urban land and muck wetland soils. Parcel 2 has a 16 acre wetland - more than half of the total acreage. The wetland is identified in Plan 1. The soil types best suited for agriculture use on Parcel 2 are (106C and 106D) Narragansett-Hollis, (223B) Scio very fine sandy loam, and (251A and 251B) Haven Silt Loam. These soil types are designated as prime farmland soil and are also suitable for building sites.

The most unsuitable types of soils for building and agriculture are (51A) Swansea muck, (53A) Freetown muck, (603) Urban land wet substratum, and (655) Urthodents wet substratum. The soil type (603) Urban land can be used for building sites but on site investigation is necessary, and pilings are usually required. This land can also be used for agriculture, however, on-site investigation and soil testing is also advised.

The Parcel 2 wetland was formerly used for agriculture, however, because this farmland has been inactive for more than 5 years, the wetlands agriculture exemption has expired, according to the Massachusetts Wetland Protection Act. Therefore the land is not available for any agricultural or development uses.

More significant, the Parcel 2 wetland contains a large area/amount of contaminated fly ash material from a plant and soil research experiment conducted in the 1970's known as the Phoenix Project (a joint USEPA, Mass DEP and City of Waltham DPW project). The University's consultant, ECS, has recommended two options for the Phoenix fly ash site. Option A would leave the fly ash material in place avoiding the need for additional permitting and disturbance of the wetland. In this option, a fence and signage would need to be erected to keep people out of the site. A permanent use restriction would be filed on the property deed. Option B would remove the fly ash from the site and reconstruct the wetland. UMass Facilities and Campus Planning recommend Option A. The next step will be to negotiate a solution with the Waltham DPW, Conservation Commission, Mass DEP, and US EPA. Under either option the wetland/fly-ash area would not be available for development due to wetland and or contaminated materials restrictions.

Parcel 2 currently has 6 structures all of which have been deemed uninhabitable or have collapsed altogether. The site is considered to be a blank slate except for the landscape features that are important considerations for any future development or use.

c3. Legal Restrictions

Deed Restriction:

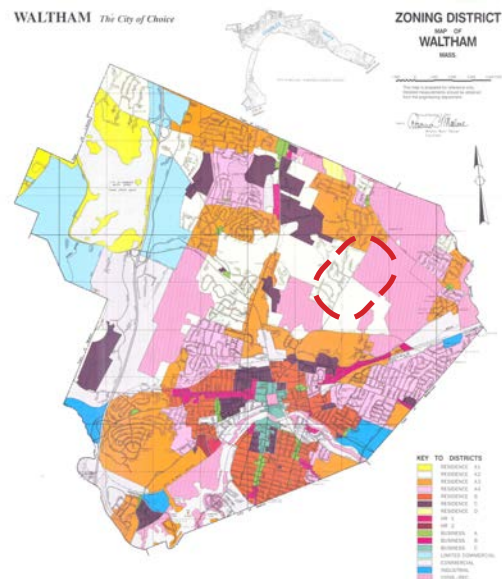
According to the Off Campus Property Report of July 20, 2002 the Waltham Experiment Station has a covenant placed on the deed. The covenant states that if the University discontinues the use of the land for teaching and research, the property will be granted to the City of Waltham. According to the 2002 Report, the property does not need to be solely used for agricultural purposes, but does need to remain in educational use by the University.

Zoning:

As a state institution, Massachusetts Building Authority, is exempt from local zoning regulations. However, in the larger context of negotiations with the City of Waltham, it may be important to know how proposed development differs from local zoning regulations. Additionally, should the University partner with a non-state development partner, the zoning exemption may not apply. The following review of Waltham Zoning regulations is offered in this context.

The City of Waltham zoning map was amended October 2007 which divides the city into 16 districts. The Waltham Experiment Station is zoned as Conservation and Recreation which allows the current community supported agriculture and nonprofit research and education uses. The Conservation Recreation District does not allow for office, commercial, or retail development. Educational use in the Conservation and Recreation Zoning District is defined in section 3.125 of the City of Waltham Zoning Ordinance as;

Educational uses: *Uses of land, buildings or structures for providing learning in a general range of subjects on land owned or leased by the commonwealth or any of its agencies, subdivisions or bodies politic, and including use of land, buildings or structures for providing facilities for research, public education and public display which are owned and operated by the Commonwealth or any of its agencies, subdivisions or bodies politic. Further, educational uses shall be construed to include any use of land, buildings or structures for providing learning in a general range of subjects on privately owned land by any educational entity accredited by the appropriate regulating authority.*



Map 4: Waltham Zoning
Source; Waltham Planning Dept.

Parking Requirements

The parking requirements for the City of Waltham are addressed in Article V of the City of Waltham Zoning Codes page Z- 69 (Waltham Zoning Code 1988). The required parking space for each use type vary as shown below.

Offices-	1 space per 300 square feet of gross floor area
Auditorium-	1 space / 3 fixed seats and 1 for each 36 square feet of unseated public floor area
Conservation/ Nature Activities-	1 space/ 3 participants

Due to the distinguishable uses of the building for office space, education, and conservation and nature activities, the parking requirements may fall under section 5.22 of the Waltham Zoning Code. This section determines a parking credit schedule based on time of use for the different uses, therefore potentially reducing the amount of parking square footage. Section 5.43 requires that 1 tree, minimum of 3.5 inches in diameter measured 6 inches from the ground, must be planted for every 10 parking spaces.

Parking and Potential Zoning Change:

If a structure, new or existing with additions exceeds 20,000 square feet shall be subject to a parking standard of 1 space per 500 gross square feet for all building area in excess of the 20,000 square foot threshold. Any structure below 20,000 square foot is not subject to the parking requirements.

Parking and Driveway Dimensions :

A standard parking space set forth by Section 5.4 of the Waltham Zoning Code is 18'x 9' with 20' aisle. However, Section 5.47 allows 25 % of the required spaces to be 16'x8' and designated as such for compact cars. A special permit may be granted to allow up to 50% compact spaces if the parking lot is in excess of 25 spaces. Entrance and exit drives may not exceed 25' wide; special permit may allow for wider if public safety benefit is apparent. An area equal to 40 square feet per space shall be provided to allow space for storage of cleared snow

Environmental Regulations:

Parcel 2 includes a 16 acre wetland subject to regulation by State Wetlands Protection Act and the Conservation Commission of Waltham. Parcel 2 also includes a large fly ash site that is remnant from the Phoenix Project described above.

Utilities and Infrastructure:

The Waltham Experiment Station South Parcel is served by public water, sewer, and electricity. Heating is provided by the boiler building that was recently converted to natural gas. The North parcel is serviced by public utilities including water, sewer, and electricity

Conclusion

This site analysis presents a physical framework for which the site can be designed to accommodate the theory and practice of addressing the challenges for UPA by UMASS Extension. The site is best viewed as a blank slate except for the important landscape and environmental considerations such as; limiting the disturbance of prime farm soils, not disturbing the flay ash deposit on the North Parcel, retaining as many significant trees as possible as well as the established tree line to buffer agriculture practices from adjacent residences. The site will be designed to not only accommodate the spectrum of programmatic elements, but also adhere to the legal restrictions on the deed and respect the requirements set forth in the City of Waltham Zoning requirements.

4. Master Plan

a. Introduction and Goals

This project is broadly about the role that urban agriculture can have in making cities and their peri-urban environments more livable and green spaces more active. Specifically, the goal of this project is to provide a master plan for the University of Massachusetts Extension Service (now The Center for Agriculture, Food, and the Environment) Waltham Experiment Station as a center for applied research to address resource needs and provide technical assistance for urban agriculture and its related activities covered in the research chapters. The research for this project addressed the historic precedent for growing food in cities, the current trends and interest in urban agriculture, and the challenges for UPA as an urban infrastructure. This design project used that important research to articulate the need for reinvestment in the Waltham Experiment Station for UPA and to inform the development of a master plan. The research on UPA and urban ecosystem services, the City of Waltham, and the site have provided the framework for a site design that provides a spatial framework for developing new UPA research and outreach programs while inversely bolstering a multidimensional urban agriculture system.

The University of Massachusetts Amherst's Waltham Experiment Station can be a model for multi-use urban agriculture production, research, and education as well as a living laboratory to monitor and document the ecosystem services provided to the surrounding community.

b. Design Objectives

The site has several existing users and programmed use of the land as covered in Chapter 3. In this sense, the master plan for the Waltham Experiment Station will become an epi-center for UPA activities. The research, outreach, and training that Waltham Experiment Station Extension staff, working in possible collaboration with urban and peri-urban farms and farmers, planners, designers, and city officials can provide to reduce the challenges for UPA, is intended to permeate the UPA community at large that could encourage the development of a regional and scaled UPA system while providing material and non-material resources for individual projects on other sites.

This project is intended to accommodate the needs of existing users while also providing space for future research, education, and food production. While the site area is obviously finite, there is an inherent mission for this center to perpetuate and strengthen an urban agriculture system across metropolitan Boston while potentially playing a leadership role across the Land Grant University Extension System for turning its attention to urban agriculture issues. To that end, the former Fernald School for example, may be available for future urban agriculture expansion with possible partnerships with those organizations at the Waltham Experiment Station while adding to the provision of ecosystem services along the Western Greenway.

The master plan attempts to balance existing uses and users who may have a sense of "ownership" to the land with an increase in public use who visit the site for education, lectures, training, office space lessee's, and recreation along the Western Greenway. The focus of this masterplan is to provide as much agriculture land as possible for both WFCF and GROW while balancing the benefits provided by existing landscape signatures like hedge and tree rows, topography, and wetlands and

associated buffers. A second organizing element is a new administration and research building and associated parking and egress that is necessary given the inventory of existing users, the potential future uses, and the public academic mission of the University of Massachusetts System. The last organizing component of this site is the Western Greenway. While the agrarian landscape and the physical plot of land is part of the larger greenway, integrating and providing a clear connection for users of the Western Greenway while also giving these users an “agrarian experience” is important.

A brief categorization of potential users was developed to understand the needs of these user groups. This was informed by the site inventory and analysis in Chapter 3 and helps to articulate clear design objectives, concept, and master plan. The design objectives for this project to be inclusive of user types while providing a spatial organization that allows for easy navigation and inclusivity of these user types was a challenge.

PRIMARY FARM USERS	PRIMARY BUILDING USE	PRIMARY GREENWAY USE
Waltham Fields CSA Employees, Farm Share Participants GROW Community Gardens Extension Staff	Leased Office Space Lecture Hall/ Events Educational Courses Technical Training Primary and Secondary School Visits	General Recreation Daily Exercise Agriculture Roads

The list above was developed to categorize the different users and their primary use of the site. For example, a person who leases office space may arrive at the site daily, but walk the grounds or greenway for exercise. This person uses the building primarily, but the agrarian and greenway landscape components compel the user to walk the greenway path, or venture down a farm road. In the same sense, users attending an event or educational course access and use and navigate the site differently than the way a full time employee of WFCF or a GROW might. A person or group of people attending an educational course or event would enter the building first, obtain information, and proceed through the building to an interior destination or at a later time to the agricultural fields. In this way, the building becomes a central organizing component and acts as a filter for which primary building users obtain information, then disperse throughout the building or into the fields. Equally, a hiker along the greenway should be compelled to stroll the agriculture landscape and community gardens, and visit the building if inclined.

To reiterate, the list above is not intended to be an exhaustive list, but provide a framework identifying which organizational components each user groups seek first, or primary, but might then seek other organizing components secondarily. This organizing components and initial list of user groups provides clear design objectives that give way to the design concept.

The design objectives are as follows

1. Site organization; organize the site for efficient agricultural production and according to how different user groups may access and use the site for their primary purpose of visit- an integrated but separate approach. The three organizing components mentioned above are the agriculture use and landscape, building(s) occupied by different users and associated infrastructure, and the greenway. The agrarian landscape is integrated into an agricultural building complex that includes a research building and associated, barns and greenhouses; WFCF share pickup and store building, barns, and greenhouses. The building is centrally located, but close to the main thoroughfare for easy identification and navigation of access whether by bike, foot, or car. The majority of farm fields and production are located behind the building.

2. Research/ Education Building: For the purpose of this project, the building will not be designed, rather a general footprint that suggests an approximate size of 20,000 sq.ft. is shown for the purpose of exploring the research and education building as a central element of organization for the site. In this way, the building becomes a filter for which secondary farm users, (those new to the site or office space occupants) enter the building and seek a destination whether it be the office they occupy or a classroom for an educational course. The building will provide such elements as private office space, interior program/ classroom space, laboratories, a flexible lecture room and a commercial kitchen for value added agriculture production. The research building is part of the building area complex to keep utilities centrally located and will allow for additional building expansion by WFCF if needed.

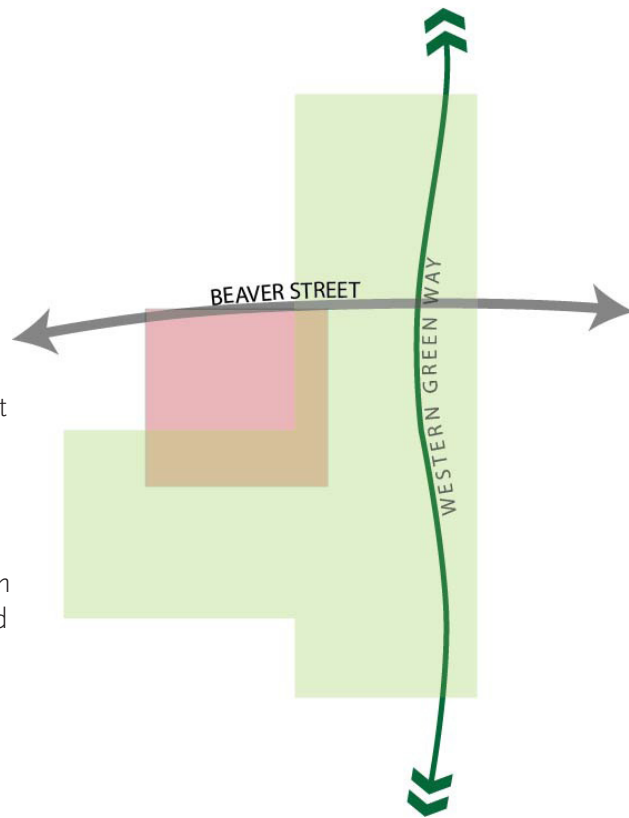


Diagram 1: Design Concept

3. Access and Connectivity

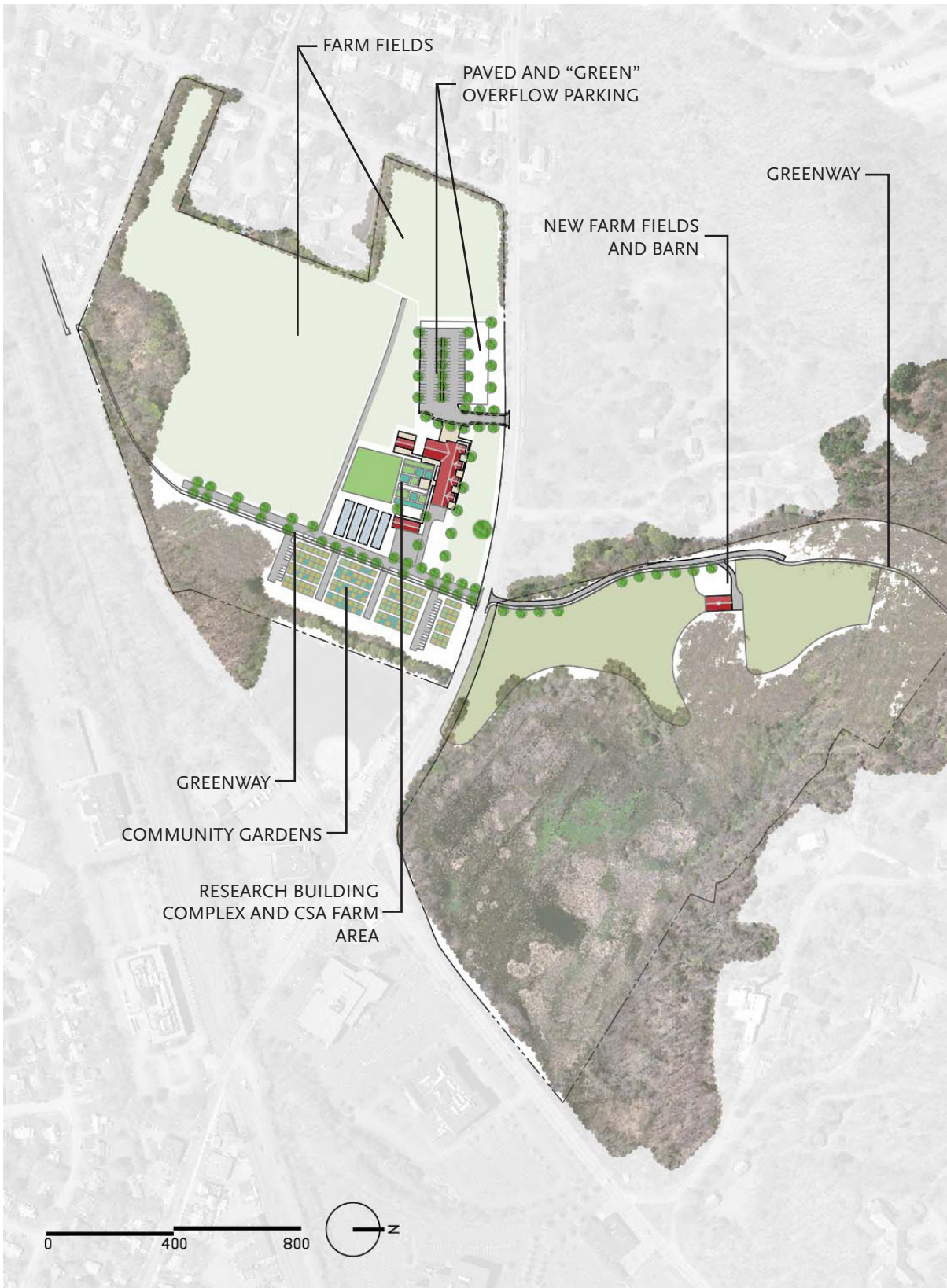
The various user groups can access the site multi-modally and by keeping the building close to the street, it becomes a more visible destination. At the same time, future development may occur on the north parcel and beyond to the Fernald School. It was an important design objective to give deference to agriculture use and primary means of connection via the existing aligned farm roads. This also maintained clear connectivity for greenway users while providing more private use, accessibility, and integrated parking for GROW members.

c. Concept

The concept for this project was informed by the goals and design objectives to design and develop a master plan that allowed for the shared use of the site by a range of user groups. To reiterate, this has been one of the challenges for this project; how to accommodate the range of users, from daily workers that occupy office space, daily farm employees, public users attending an educational seminar, community garden members interested in leisure and personal food production, and public greenway users who might enjoy a stroll and a view of this remaining agrarian landscape. The concept generally can be expressed as providing a farm experience for all users where the new research building is nested as an agrarian complex of buildings and barns for attracting users and allowing them to disperse across the agrarian landscape.

d. Master Plan

A master plan was developed to convey a general spatial layout that accounted for the spectrum of existing and future uses for the Waltham Experiment Station. The buildings for public and private use



Plan 2: Waltham Experiment Station Masterplan

and enterprise and clustered in a “complex” with clear egress and parking for the more “public” users attending a class, a lecture, or using commercial office space. This complex is close to the road with lesser areas for agriculture along the street, though enough area and visual connection to the road for providing an agrarian aesthetic to those “passing by.” Most of the agriculture fields and research takes place behind the building or across the street, while using trees, and active fields to knit the building complex and mixed uses into the agrarian landscape.

RESEARCH BUILDING COMPLEX:

The research building complex is anchored by a two story research and office building totaling 20,000 sq.ft. Directly attached to the research building and included in the square footage is a flexible lecture and event room that opens up to raised bed garden plots that can be used for research and demonstration. These plots are organized as a designed garden around a 30'x30' outdoor event and patio space directly south of the building. Workshop space south of the research building and the Waltham Fields Community Farm (WFCF) farm-share store and pickup area enclose the raised beds and small “residential” scale garden plots. The garden plot area enclosed by the buildings and WFCF greenhouses totals approximately 26,000sq.ft., including circulation for people and equipment.

Primary Parking:

Parking is provided for the research and administration to the general public taking a class or office space users in a traditional paved parking lot that could include green infrastructure measures to address stormwater and provide space for tree plantings. The parking is located directly west of the building. A secondary “green” parking area is shown for additional and even parking. The traditional paved parking area can accommodate 82 cars and also provides a drop off area for buses. The secondary intermittent parking area provides space for up to an additional 100 cars.

FARM FIELDS:

The master plan provides 18.5 acres of cultivated fields. This would require some reclamation work on the north parcel, but the fields as shown consider the limits of existing wetland buffer and topography. Some tree clearing would be required but is allowable. A new barn is also shown on the north parcel and can be used either by public or private entities. The new barn is nested into the topography such that the floor elevations of the barn could provide direct access to the fields. The southern field would have direct access to the bottom level of the barn at grade while the second level of the barn could provide at grade access to the northern field. The barn would be two stories in this scenario and total 7,000sq.ft. of floor area.

WALTHAM FIELDS COMMUNITY FARM (WFCF) and GREEN ROWS OF WALTHAM COMMUNITY GARDENS (GROW):

The farm road has been preserved in its existing location. This provides a number of opportunities including a clear greenway connection and agriculture experience for users, but also provides WFCF and GROW a separate entrance for farmshare pickup or garden plots respectively. Preserving this road but enhancing its agrarian character also provides a clear distinction for farm uses. WFCF share pickup is located on the east side of the building complex and is complete with greenhouses. Parking for each use is integrated either at the share pickup building or within the community garden plots. The 18.5 acres of fields would be divided up as needed between research, extension uses, and WFCF, but nonetheless is over a 100% increase in productive land. GROW has experienced an increase in demand for garden plots. The master plan provides 10 more garden plots, plus integrated parking, adjacency to the building complex for utilities, and the potential for expansion in the southwesterly

direction along the farm road and Western Greenway Trail.

THE WESTERN GREENWAY:

The Western Greenway is comprised of a connected parcels of land protected for their openspace quality and provision of ecosystem services. At this large scale, the Waltham Experiment Station site is one of those parcels that is protected for its open space quality but being activated to provide a different set of ecosystem services than much of the other preserved forests, fields, and historic sites of the greenway. Here, the greenway provides an opening in the literal and figurative sense for an agricultural landscape experience of productive fields, garden plots, gravel roads and fieldstone walls directing the user in a north/ south fashion across the site. Of course, exploring the fields and community plots is a possibility for this public land.

This design project was intended to be a master plan that incorporated large conceptual ideas for continuing and elevating the discussion for UMASS Extension and UPA. This project can and should be used as a discussion peice for developing full design plans, something this masters project fell short of. However, through the academic and site research, most, if not all of the important components for developing such a site have been considered.

5. Project Conclusion

This project views the topic of urban and peri-urban agriculture as a new strategy for food production and consumption trends in an urbanizing world, where demand for healthy and nutritious food and water will only increase. It posited that Land Grant University Extension Services and the six major areas of service within a community; *youth development, agriculture, leadership and development, natural resources, family and consumer sciences, and community and economic development* has many of the same themes for social and environmental justice of urban agriculture. University or Cooperative Extension can have an important role to play in addressing the challenges and barriers for UPA such as maintaining cultural diversity and access to healthy food, institutional barriers like zoning regulations, and addressing resource needs from technical assistance and funding opportunities to developing networks among urban and rural farmers. Through research and literature review, this project documented the overlap in social, economic, and environmental agendas and missions of urban and peri-urban food production and areas of research, study, and outreach of University or Cooperative Extension Services.

Though university extension has traditionally addressed these concerns in rural communities, the continued trends for a rural-to-urban population migration and the continued increase in urban or suburban landscapes suggests that the important programming of extension services will need to meet this changing demographic and landscape. Growing food in cities, and their peri-urban fringes, occurring in many shapes and sizes across history has both shaped, and been shaped by, the process of urban development. Urban food production seems to have entered a new and exciting phase given its historical precedent and the current trends for urbanization by addressing the social, economic, and environmental issues surrounding cities and food production and consumption.

Given urban agriculture as a broad response to issues surrounding urbanization and food, it runs the risk of being an elusive panacea lacking definition, measureable benefits, clear and attainable goals,

and this resulting in unsuccessful planning and implementation as an urban system. This would be a bust for a more equitable food system that can provide healthy and nutritious food-to-food insecure populations, but also potentially provide a broad suite of urban ecosystem services. The potential failure of such a system could be avoided in part by strengthening the presence of University Extension in a city or region that could refocus its programs on urban and suburban issues through urban agriculture.

University or Cooperative Extension addresses many of the same socio-economic and environmental issues that UPA seeks to address. Additionally, University Extension's applied learning and research techniques and "learn by doing" model for community outreach can strengthen UPA in the communities it serves by; defining and developing UPA typologies; addressing the resource needs for urban food production; develop networks for philanthropic investment and funding; provide technical assistance, and "learning by doing" for urban and peri-urban farm operations; study and research the success and failures of urban food projects; be an integral player in the study, research, and planning of a linked system for urban food production, distribution, and waste stream recycling from city center to peri-urban. Lastly, as the study and understanding of urban ecology increases in a world becoming increasingly populated and urban, University Extension Centers support urban and peri-urban laboratories for studying and documenting the relationship between food production and the suite of ecosystem services that could be provided. This project successfully documented the need for technical assistance, education, and reconnecting urban dwellers to the land as a learning experience, a functional role for Extension and a valuable, albeit difficult-to-study cultural ecosystem service.

This project proposed a master plan for the Waltham Experiment Station to meet the need for addressing the barriers for urban agriculture by incorporating the existing spatial and programmatic needs of the food production activities of WFCF and GROW and the academic climate change studies. This site design has planned for the future development of such activities while allowing UMA Extension to increase its presence in UPA at the site. This requires the provision of space on the site for program development, training, and education that could operate in conjunction with the existing and future food production and environmental studies programs. The intent of this project is to make the claim for strengthening Extension Programming for this global phenomena of UPA while providing the specific framework of cultural ecosystem services for evaluating and quantifying those benefits provided to humans. There are many directions that this project could have taken- the two most relevant for Extension and for Planning and design for a UPA system in metropolitan Boston include; long term and consistent funding for Extension Programs across the entire Land Grant University System and the design and planning for linked and scaled UPA projects that form a true system or network for food production, distribution, and organic waste recycling. The City of Boston through the Boston Redevelopment Authority and many of the surrounding cities have initiated and support urban farming, but it appears that no real spatial and programmatic plan for linking existing and proposed UPA activities exists. Reynolds, (2011) touched on the lack of nation-wide Extension program with a focus on UPA and that budget short-falls continue to plague extension, even as its mission to deliver research-based education to the public remains. This project could provide some framework for future program development and continue the discussion for developing connected, contiguous, and scaled urban green spaces for increasing urban ecosystem services and urban food production - especially considering its proximity to the largest tract of reusable greenspace within Interstate-95, at the former Fernald School.

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