LeadingCities
Making Smart Cities Smarter

Smart Agriculture in Boston

The Frontier for Industry Growth, Community Engagement, and Food Security

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LETTER FROM THE PRESIDENT

The Mission of Leading Cities is to improve the quality of life in cities worldwide. To achieve this, Leading Cities is committed to the sharing of best practices among cities globally and to foster the adaptation and adoption of Smart City solutions in our partner cities. We believe the highest quality of life in cities is achieved by pursuing sustainability goals from an ecological, economical, and sociological perspective.

With 80% of the world's resources being consumed within cities, which occupy just 2% of the Earth's landmass, city leaders are developing new policies, strategies and visions for generating less carbon emissions, consuming less energy and producing more urban agriculture. As the threats of climate change, food scarcity, economic hardship continues to present growing challenges for cities, Leading Cities has begun to explore the opportunities our partner cities have to address these urban challenges.

In this Brief, Emil Ghitman Gilkes presents the opportunities possible for the city of Boston to pursue a more aggressive urban agriculture agenda. His work concludes with a set of strategic recommendations that, if followed, will provide economic, environmental and sociological advantages. A vision for urban centers becoming agricultural centers, as Mr. Ghitman Gilkes describes, is not only possible, but in some cities this vision has already begun taking root.

City leaders around the world who share a new vision for the positive impacts of urban agriculture will not only improve the healthy eating of residents, but will develop industry opportunities and create avenues for both urban agriculture and economic development more broadly. Leading Cities is committed to improving the quality of life in cities worldwide through the sharing of best practices and the collaboration among business, civic, academic, non-profit and citizen leaders. We believe that urban centers globally will continue to transform themselves in order to meet the increasing needs and demands on services that result from growing urban populations. As you will read in this brief, urban agriculture represents one such transformation—the transformation of city spaces into food producing, economic engines for local communities and neighborhoods. We encourage you to read, learn, share and engage with us to further develop this opportunity in Boston and around the world.

Respectfully,

Michael Lake
President & CEO

Thank You

Leading Cities would like to express our gratitude for a number of individuals whose support and effort made this research and report possible. First, we would like to thank Emil Ghitman Gilkes for his passion for this subject and commitment to this research project. In addition, we are grateful for the time and valuable information and insights provided by the various experts and practitioners throughout this project. In particular, we would like to thank the following interviewees:

- Katie O'Sullivan, Program Development & Support, Freight Farms, Inc.
- Rose Arruda, Urban Agriculture Coordinator, Massachusetts Department of Agriculture
- Renée Vassilos, AgriBusiness Consultant
- Rachel Greenberger, Director, Food Sol at Babson College
- Helena Fruscio, Deputy Assistant Secretary of Innovation and Director of the Office of Performance Management, Commonwealth of Massachusetts

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Introduction

Over the next century, as the world population grows and climate change transforms our land, water, and society, each and every city will be forced to evolve in order to house, feed, and protect their present and future citizens. Adding to the pressure on cities are projections that two-thirds of the world's population will live in urban areas by the mid-21st century.[1]

Some cities already experience problems associated with growing populations and climate change. A chronic shortage of affordable housing in New York City has caused a 79 percent increase in demand for shelter in the last decade.[2] London's Infrastructure Plan predicts that over £1 trillion is needed between now and 2050 to support the city's population and economic growth—London is currently building housing at 50% the rate needed to satisfy its projected demand.[3] Adding to this are 15 of the world's 20 megacities at risk of rising sea levels and coastal surges.[4]

As a result of these frightening projections, cities around the globe, big and small, developed and undeveloped, have begun to invest in "Smart City" solutions. Smart City solutions include technologies such as Internet of Things, systems that add connectivity to urban services (e.g. sensors that monitor and optimize energy consumption in targeted areas of a city, or smart trash bins that monitor waste levels and optimize collection routes). Nontechnological solutions include programs that tap into university talent to provide inexpensive, quality labor for municipalities (e.g. Harvard's fellowships for students to work in local government). An additional example is participatory budgeting, in which community members directly decide how to spend part of a public budget.

Persistence Market Research, a market intelligence consulting firm, forecasts the Smart Cities market to, "surpass US$ 1 trillion in 2019 and take a leap to US$ 3.48 trillion by 2026 end."[5] At the same time, the American Society of Civil Engineers' 2017 report card rated America's infrastructure (including our technology/"smart" infrastructure) a D+ and claimed that Congress and the states must invest an additional $206 billion each year to prevent the economic consequences of failing infrastructure and to maintain global competitiveness.[6]

The need for U.S. investment in Smart Cities solutions has been met with government initiatives and public-private partnerships at federal, state, and local levels. Programs such as the U.S. Department of Transportation's Smart City Challenge, and Atlanta's Renew Atlanta Infrastructure Bond, are just two examples of how different levels of government are driving innovation in the smart cities market.

Boston, Massachusetts, the focus of this report, is well-known for innovation in the Smart City space. Former Mayor Thomas Menino was a pioneer in launching the Innovation District, creating the Office of New Urban Mechanics, and supporting business start-up accelerator programs. Current Mayor Marty Walsh has maintained Boston's commitment to climate change readiness (e.g. Greenovate Boston 2014 Climate Action Plan Update) and to global leadership in innovation (especially in art, science, and technology) Boston has also made strides in developing solutions to address food and security issues. This report evaluates the potential for

[1] Department of Economic and Social Affairs: Population Division, *World Urbanization Prospects, Highlights* (United Nations, 2014), 1.

[2] Giselle Routhier, *State of the Homeless 2017: Rejecting Low Expectations, Housing is the Answer* (Coalition for the Homeles, 2017), 1.

[3] Jo Valentine, "If London is to cope with its growing population, the city needs greater devolution," *CityMetric*, January 9, 2015.

[4] Urban Development & Local Government, *The Impact of Climate Change on Cities*, (The World Bank, 2010), 8.

[5] "Global Smart Cities Market to Reach US$3.48 Trillion by 2026, APEJ to Outpace North American," *Cision PR Newswire*, January 4, 2017.

[6] American Society of Civil Engineers, *2017 Infrastructure Report Card: Economic Impact* (ASCE, 2017).

urban agriculture to help satisfy a multiplicity of needs and wishes in Boston and its residents. Although many consider urban agriculture to be a novel idea, promotion of the concept in Boston began in the 1970s. The goal at the time was to beautify and improve depressed areas, provide low-income neighborhoods with healthy food, and drive economic development. Urban agriculture continues to expand in Boston with farms such as Green City Growers and the Urban Farming Institute providing Bostonians fresh food on a commercial scale, and companies such as Freight Farms offering innovative solutions to improving the efficiency and profitability of urban agriculture.

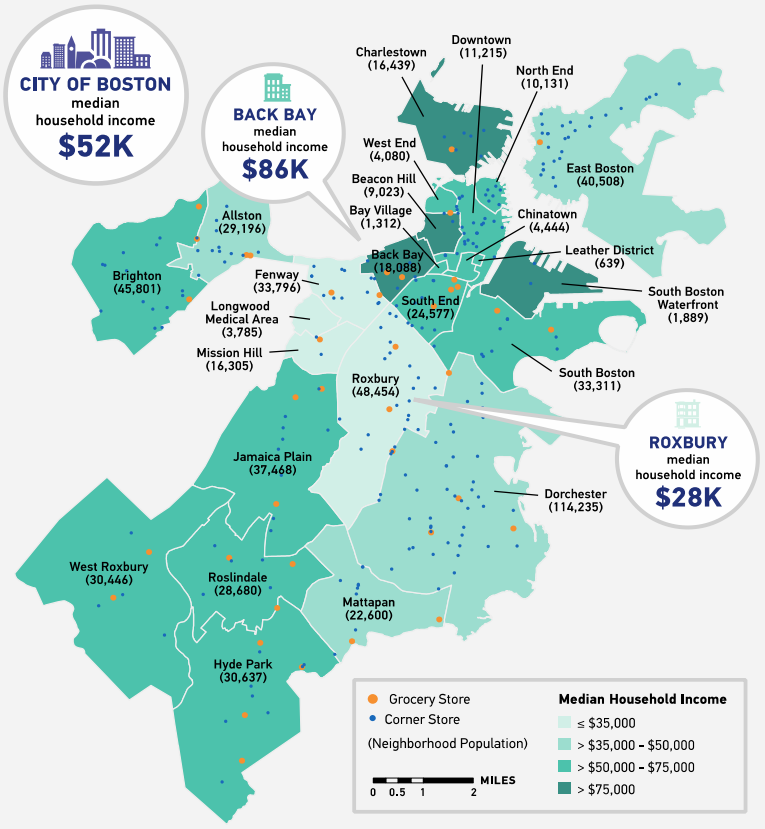
Boston's Needs and Ambitions

Boston's opportunity to expand urban agriculture begins with the universal need for cities to improve food security. Urban populations are growing at an unprecedented rate and conditions of land currently used to grow food are declining due to pollution and climate change. Shockingly, according to the U.S. Department of Agriculture (USDA), 12.7% of U.S. households (a full 15.8 million households) were "food insecure" in 2015. The USDA defines a food insecure household as "uncertain of having, or unable to acquire, at some time during the year, enough

FOOD AVAILABILITY VERSUS FOOD AFFORDABILITY

Income Disparities Create Food Deserts in Boston

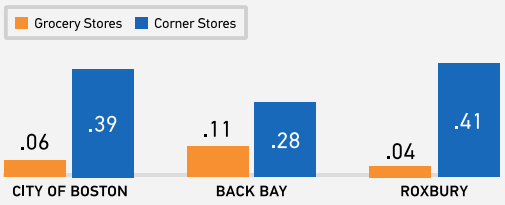
INNER CITY IN FOCUS



SNAPSHOT PRICE COMPARISON

	BACK BAY		ROXBURY	
	Grocery Store	Corner Store	Grocery Store	Corner Store
GALLON OF MILK	$4.49	$4.69	$4.99	$4.75
CHICKEN SOUP	$1.39	$1.69	$1.25	$1.49
LOAF OF BREAD	$1.39	$1.99	$1.29	*Item not available*
ICEBERG LETTUCE	$1.69	*Item not available*	$1.99	*Item not available*
CHICKEN BREAST	$5.99/lb.	*Item not available*	$6.99/lb.	*Item not available*
INFANT FORMULA	$1.17/oz.	*Item not available*	$1.21/oz.	*Item not available*

STORE AVAILABILITY PER 1,000 POPULATION



Inner City in Focus 7, ICIC, March 2015. Sources: Boston Redevelopment Authority (BRA), 2014, Boston Neighborhood Shapefiles, http://bit.ly/1cbHcoF; BRA, 2013, Grocery Stores in Boston, http://bit.ly/1BdgJ1M; BRA, 2014, Neighborhood Profiles: City of Boston, http://bit.ly/1oDrmEw; Mayor's Office of Food Initiatives, 2013, Corner Stores, http://bit.ly/1NSxxF6; ICIC survey of grocery stores and corner stores 2/18/15 & 2/19/15; ICIC Analysis.

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ICIC

food to meet the needs of all their members because they had insufficient money or other resources for food."[7]

Although Massachusetts is well below the national average for food insecurity, 9.74% of households in our state were food insecure from 2013-2015, or almost 250,000 households. Narrowing the scope to Suffolk County, according to Feeding America's "Map the Meal Gap" project, 14.9% of individuals (higher than the national average) in the county are food insecure. Moreover, 18% of food insecure individuals in Suffolk County are not eligible for the Supplemental Nutrition Assistance Program (SNAP), meaning they receive little or no aid to help feed themselves.[8] Though former Mayor Menino attempted to eliminate food deserts by adding more grocery stores (opening five in the Downtown area, Fenway, and Jamaica Plain) it is evident that these attempts fell short as the wealthiest neighborhoods, such as Back Bay, have disproportionately better access to quality food compared to neighborhoods such as Roxbury, Dorchester, and Mattapan, which are serviced mainly by corner stores carrying limited food options. (See graphic for an Inner City In Focus' illustration of food availability and affordability in Boston.)

While food insecurity is a critical target of urban agriculture, consumer preference and climate change trends also support the tremendous value and need for urban agriculture expansion. A 2015 report by Packaged Facts—"Shopping for Local Foods in the U.S."—estimated that locally sourced foods generated $11.7 billion in sales in 2014 (about 2% of the US food/beverage market). Packaged Facts predicts that local foods will grow faster than the annual pace of total food and beverage sales, to approach $20 billion in 2019. A National Consumer Survey conducted by Packaged Facts in 2014 found that 53% of respondents intentionally seek out locally grown or locally produced foods. Moreover, almost half the respondents expressed willingness to pay up to 10% more for locally grown or produced foods, and almost a third said they are willing to pay up to 25% more. A full third of consumers claim to *consciously* purchase locally grown or locally produced foods at least once a week.[9]

Adding to these bullish findings for the local food market in the U.S. is the National Restaurant Association's "What's Hot: 2017 Culinary Forecast" in which "hyper-local sourcing" was number one on the list of top ten "concept trends."[10] There is proven demand for locally-sourced food across the U.S. However, the current food supply chain around Boston and its environs does not measure up to concept trends and consumer wants: about 90% of New England's food comes from outside the region.[11] There is tremendous opportunity for Boston and the region to tap into the local food market and expand agricultural innovations, opportunities, and investment.

In addition to reducing food insecurity rates and offering growth opportunity in the local food market, urban agriculture has the potential to assuage some of the threats brought on by climate change in Boston. According to Boston's Climate Vulnerability Assessment, "by mid-century, 7 percent of the total land area in the city could be exposed to storm water flooding for the 10-year, 24-hour event, with that percentage increasing to 9 percent by the end of the century."[12] Storm water management and sewage overflow poses problems for many cities, but the problem is exacerbated by Boston's coastal location. The conventional strategy to address sewage overflow is to invest in "grey infrastructure" such as increased-diameter sewage pipes, expanded water pollution control facilities, or tanks to store sewage

[7] United States Department of Agriculture, *Food Security in the U.S.* (USDA, 2017).
[8] Map the Meal Gap, *Food Insecurity in Suffolk County* (Feeding America, 2015).
[9] Packaged Facts National Consumer Research Survey, *Shopping for Local Foods in the U.S.* (Packaged Facts, 2015).
[10] National Restaurant Association, *What's Hot: 2017 Culinary Forecast* (NRA & Restaurant.org, 2017), 3.
[11] Brian Donahue et al., *A New England Food Vision* (Food Solutions New England, 2014), 2.
[12] *Climate Vulnerability Assessment* (City of Boston, 2016), 40.

until it can be pumped back through the water pollution control plants once the rain stops. A potentially more cost-effective and innovative option is to increase the permeability of the cityscape through forms of "green infrastructure," such as parks, landscaped median strips on roadways, permeable pavement, and agricultural sites. Green infrastructure is multifunctional as it can increase biodiversity while providing all the benefits associated with urban agriculture.

New York City's Green Infrastructure Program exemplifies the use of green infrastructure as an alternative sewage management system. NYC's Department of Environmental Protection deemed investment in green infrastructure to be more cost-effective: "Over 20 years, the green scenario would cost USD 5.3 billion, including the USD 2.4 billion for this green infrastructure. In contrast, an estimated USD 6.8 billion would be required for a scenario based solely on the types of grey infrastructure.[13]

While urban agriculture holds the potential to play a massive role in sewage management and greening of infrastructure, the consent orders (legally binding orders given by governments to private contractors) driving green infrastructure mandate water management but do not prioritize urban agriculture and the additional benefits it brings. To prioritize urban agriculture as a means for sewage management, "Municipalities should coordinate green infrastructure investments with municipal urban agriculture goals to most effectively support both."[14] This coordination maximizes the return on investment in green infrastructure as the outcome will provide upgraded sewage management as well as the benefits of urban agriculture.

The Green Infrastructure Research Group, University of Melbourne

Current State of Urban Agriculture in Boston

Boston's food insecurity rate, growth potential in the locally-sourced food market, and need to address sewage management together offer significant opportunities for urban agriculture—ranging from community gardens to commercial vertical farming—to play a larger role in the city's economic growth, job creation, and resilience to climate change. To assess the opportunities for urban agriculture in this historic city, it is first necessary to evaluate what is currently being pursued in Boston and the region.

In large thanks to former Mayor Menino's sustainability policies and Mayor Walsh's continued support to make Boston a leader in sustainability, Boston was ranked a close second behind New York as the most sustainable North American city by the ARCADIS Sustainable Cities Index. Boston also was ranked number one by the American Council for an Energy-Efficient Economy in the "City Energy Efficiency Scorecard," and Mother Nature Network ranked Boston third

[13] NYC Department of Environmental Protection, *NYC Green Infrastructure Plan* (City of New York, 2010), 9.

[14] Nevin Cohen and Katinka Wijsman, "Urban Agriculture as Green Infrastructure: The Case of New York City," *Urban Agriculture Magazine*, 19.

in a list of the 10 "greenest cities" in the US.[15] Boston's commitment to sustainability and green initiatives is demonstrated in the more than 200 community gardens over 50 acres of the city, more than 100 public schools equipped with gardens, and initiatives that support commercial urban farms such as Higher Ground Farm, Garrison-Trotter Farm, and more. Many of these farms were made possible by a partnership between The Trust for Public Land (TPL), the City of Boston, the Urban Farming Institute of Boston, and Dudley Neighbors Inc. The partnership, formed in 2014 following Boston's "right-to-farm" by-law known as Article 89,[16] pledged to invest $1 million over several years to turn some of the 2,600 vacant lots throughout Boston into urban farms.[17] As a result, City Growers LLC has started, or acquired land needed to start, seven urban farms across Dorchester, Roxbury, and Mattapan. Green City Growers, which converts unused commercial, municipal, educational, and residential spaces into urban farms, has grown over 175,000 pounds of organic produce over less than 2 acres of land combined.[18] According to the USDA, the average American consumed about 688 pounds of fruits and vegetables in 2011.[19] Using Green City Growers' production levels, 87,500 pounds of fruits and vegetables can be grown per acre per year. Therefore, if 14.9% of Suffolk County residents are food insecure, or 117,000 individuals, just 1.6% of Boston's 57,363 acres of land would be needed to meet the needs of at-risk Bostonians. These calculations should be taken with a grain of salt as conventional farming methods cannot be utilized the entire year, and certain food products realistically cannot be grown (or raised) in an urban environment. However, considering Boston's 2,600 vacant lots, urban agriculture can do a great deal to assuage food insecurity.

In addition to the above initiatives that provide fresh, local, affordable, and even free produce to Boston residents, innovative hydroponic technologies have been implemented to maximize output per square foot per year, grow year-round, and avoid soil contamination hazards. Freight Farms, based out of South Boston, converts freight containers into hydroponic farms that take up little space and can be installed almost anywhere. One such container is located under the I-93 overpass and supplies the B.Good chain of restaurants with fresh, local greens. Green Line Growers in Brookline is another example of a hydroponic farm that supplies its community with fresh, local produce year-round. The Open Agriculture Initiative at the MIT Media Lab works to build more sustainable food systems to enable and promote transparency, networked experimentation, education, and hyper-local production. These are just a few examples of innovative food systems being employed in Boston.

Barriers to the Expansion of Urban Agriculture

Boston should be proud of the number of community gardens and innovative food systems available to its residents. However, many farms only operate for a small fraction of the year and the fresh produce available in retail stores rarely comes from in-state or even within the region. For example, one local garlic farmer in Oakham, MA cannot compete with prices of Chinese garlic suppliers (Chinese garlic has an estimated 80% share of the U.S. market), forcing him to sell value-added products such as pesto.[21]

Multiple barriers stand in the way of expanding urban agriculture to commercial scale.

[15] Lance Hosey, "Is Boston the Greenest American City?" *Huffington Post*, February 9, 2015.
[16] Urban Agriculture Working Group, *Article 89 Made Easy: Urban Agriculture Zoning for the City of Boston* (City of Boston, 2014).
[17] "Garrison-Trotter Farm," *Trust for Public Land*, 2016.
[18] *Green City Growers*, 2017.
[19] United States Department of Agriculture, *Food Security in the U.S.* USDA, 2017.
[21] Mike Lipka, "Do you know where your garlic comes from?" *Boston Globe*, December 18, 2011.

Exorbitant costs for space is typically the first obstacle mentioned by urban agriculture professionals. Private investors often shy away from commercial urban farms largely due to the high-cost of real estate and the long profit horizon. Moreover, public officials are hesitant to dedicate public land to urban farms versus affordable housing, especially when current laws restrict farming on residential land.

Exacerbating the problem of real estate costs are zoning and land use policies that make obtaining necessary permits and licenses for urban farming extremely time consuming and expensive. Some zoning regulations outright restrict urban farms. Adopted into law in December 2013, Article 89 was the newest addition to the Boston Zoning Code, addressing an array of urban agriculture activities, including rooftop, hydroponic, aquaponic farming (for more information click here). Though Article 89 relieved prospective urban farmers of numerous restrictions, there remain difficulties with zoning ordinances and land use policy. For instance, Article 89 does not permit housing on the same property as urban farm sites. This represents one policy area that could facilitate expansion of urban farming: maximizing a property's multifunctional capacities by building affordable housing around an urban farm of less than one acre would might offer a more cost-effective utilization of the land.

Incentivizing Urban Agriculture

In addition to land cost issues, access to capital is a second key barrier to expansion of urban agriculture. Reducing these barriers is complex and involves city and state officials, farmers, and residents. Numerous initiatives are pursuing expansion of urban agriculture in Boston, many adapting best practices from other cities and states.

California and Missouri have more comprehensive zoning policies than Boston's Article 89. Both states created legislation to incentivize landowners to use their property for urban farming, at least temporarily. California's law "allows a county or city to establish an Urban Agriculture Incentive Zone (UAIZ) for the purpose of supporting local food production and authorizes cities and counties to enter into contracts with landowners who agree to restrict the use of their land for a minimum of five years for small-scale agriculture production. Landowners then have their land assessed at a lower rate based on the average per-acre value of irrigated cropland in California.

A city or county with a UAIZ program may establish regulations for implementing and administering the program, including assessing a fee to cover the cost of the program and cancelation fees for exiting a contract early."[22] Missouri's law is similar, but also tackles the high cost of tapping into a water source. Missouri's law, "Requires a grower UAIZ to pay wholesale water rates for water consumed on the zone property and pay 50% of the standard cost to hook onto the water source if the water service is provided by the municipality."[23] Therefore, not only do the farmers receive a discounted water rate, the law encourages farmers to use the city as their water source, therefore providing additional revenue for the municipality.

Given that Boston property taxes are not based on how the property is used, tax policy penalizes urban farmers by not allowing their land

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[22] "Urban Agriculture State Legislation," *National Conference of State Legislatures*, April 3, 2017.

[23] Ibid.

to be valued at an agricultural rate. One avenue around this policy is to create a non-profit farm, as nonprofits are tax exempt. A community land trust (CLT) is one possibility, currently being explored by the Dudley Square Neighborhood Initiative. In this case, the CLT leases the land to the Urban Farming Institute. However, a more comprehensive solution would be one like HB 1062 passed by Baltimore, Maryland in 2010, which "authorizes the Mayor and City Council of Baltimore City or the governing body of a county or of a municipal corporation to grant a tax credit against the county or municipal corporation property tax imposed on specified urban agricultural property."[24]

While tax incentives and zoning and land use policy can improve land affordability, urban farmers also struggle to gain the required capital. The Massachusetts Department of Agricultural Resources has launched the Urban Agriculture Program, which provides funds for development of urban farming initiatives. Further examples of funding initiatives include Texas' HB 2994, which "authorized the Texas Agricultural Finance Authority's Board of Directors to establish an urban farm microenterprise support program. The program supplies loans that expand, renovate, improve or establish new urban farm microenterprise programs. Urban farms must be owner-operated and located in areas of [at least] 500,000 persons."[25] Additional support from governmental agencies could provide the necessary capital for urban farmers to lay a foundation and then seek financing through private investors, who currently see start-up costs as too high.

Moving Forward

The growth potential for urban agriculture is significant, and its impacts straddle economic, environmental, and social gains. However, given that the benefits (and costs) of urban agriculture span sectors and stakeholders, broad commitment and collaboration is necessary for urban agriculture to grow in Boston. This challenge begins with individual residents to make the case to the city of Boston that he or she cares deeply about where Boston's food comes from, and why this issue is important to the economic development and sustainability of the city.

The growth of urban agriculture in Boston must begin with education and training programs at several points. First, residents should be educated on the importance of improving food security (especially as climate change threatens our current agriculture system), and the additional social (e.g. community building, youth programs, etc.) and economic (e.g. job and industry growth) benefits of urban farming. Community groups, farmers, and other stakeholders must then mobilize those residents to both push government officials to work on the expansion of urban agriculture, and to create an environment for innovation in the space. Creating a movement around urban agriculture is an ongoing effort, and the passing of Article 89 and funding for the Urban Farming Pathways Initiative are evidence that the efforts are being rewarded.

Expanding educational opportunities to expose prospective and existing farmers to innovative farm systems such as hydroponics, aquaponics, and Open Ag at the MIT Media Lab, will eventually drive growth in the industry. In addition to educational programs, innovative partnerships must be formed and restrictive zoning ordinances should be revised. Under current regulations, the City must decide between using a vacant lot *exclusively* for an urban farm or for affordable housing. We must investigate further why regulations see urban farming as incompatible with housing complexes. In addition, the City could incentivize developers and existing landowners to include urban farms on their properties. Real estate has the potential to be multifunctional, and this capability should be exploited. Fenway Farms and Higher Ground Farm (located on the rooves of Fenway Park and the Boston Design Center, respectively) are ideal

[24] Ibid.

[25] Ibid.

examples of forming profitable partnerships by utilizing unused space.

Shortened grow seasons and extreme weather events threaten our traditional farming methods. We must educate and retrain prospective and existing farmers on how to evolve with our changing world. While lack of private investment makes it difficult to implement innovative technologies, commitment by the City and its residents will help to build the infrastructure needed to persuade private investors to join the harvest.

Strategic Recommendations

1. Further educate the public on currently available urban agriculture space, its benefits, and opportunities for growth.
    a. Branch Food's Boston Food Network
2. Promote the agriculture industry as an appealing career opportunity for high school and university students.
    a. Open Agriculture Initiative
    b. Green Bronx Machine
3. Develop educational programs for current and prospective urban farmers to learn the various farming methods and the financing opportunities available to them.
    a. Visit the City of Boston's "Want to Start a Farm" page for a list of resources on necessary permits, funding options, and training programs
    b. Further examples of urban agriculture training programs include: Farm School NYC, Urban Farming Institute, and Farm One
4. Revise zoning ordinances to permit urban farms under one acre in residential zones, offer tax incentives to land and business owners for implementing urban farming sites, and improve financing opportunities for start-up farmers.
    a. Urban agriculture state legislation
5. Seek out public-private and private-private partnerships to utilize unused space and maximize utility of urban real estate.
    a. Higher Ground Farm
    b. Freight Farm under Interstate 93
    c. Whole Foods Market Lynnfield rooftop farm

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