Research Paper

Reviving Suburbia:
Integrating Urban Agriculture for Sustainable Community Development in the Boston Metropolitan Area

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Abstract

By turning the suburban sprawl along Boston's Route 128 into a fruitful agricultural center, the project seeks to remedy the environmental damage brought on by too much asphalt and careless urban growth. Through the incorporation of urban agriculture into the suburban environment, the project promotes community involvement, revitalizes the ecosystem, and increases local food security. The project's effects on biodiversity, soil health, and social cohesion are assessed in this study using a combination of research approaches, such as stakeholder consultations, ecological evaluations, and GIS mapping. Significant gains in community resilience and environmental health are shown by the findings, providing a scalable model for sustainable suburban development.

Keywords

urban griculture, ecological restoration, suburban sprawl, community engagement, sustainability, local food security

1. Introduction and Project Context

1.1. Challenges of Suburban Sprawl

Similar to other suburban fringes in America, the growing suburban areas surrounding Boston's Route 128 have had significant negative effects on the environment and society. The growth of Westwood, Massachusetts, in particular, is a prime example of how issues common to expansive areas coexist with high property values maintained by appealing commuting options. Critical environmental indicators have been impacted by the widespread use of asphalt, which has also reduced green spaces, disturbed local ecosystems, and increased carbon emissions (Arnold and Gibbons, 1996; Ferguson, 1998). A rising worry in contemporary urban design is the pollution of water resources caused by stormwater runoff, which is exacerbated by the large impervious surfaces and the lack of public spaces (Booth and Jackson, 1997; Frumkin, 2002; Transit Cooperative Research Program, 1998).

Duany, Plater-Zyberk, and Speck (2000) noted that the effects of sprawl include ecological damage, increased traffic congestion, and community separation, all of which impair local resilience and the standard of living for locals. The Route 128/University Park Station neighborhood in Westwood, which is positioned as a suburban location with easy access to Boston, must contend with the demands of changing demographics and sustainability while also attracting a lot of commuter interest. The region's stability and modest transition in relation to suburban developments are reflected in its essentially static state since its

peak in the 1970s. To refocus attention from city centers to integrated neighborhoods that blend residential spaces, natural landscapes, and transit connectivity, modern urban planning is increasingly examining suburban peripheries for possibilities. Westwood enjoys great transit connections, including ties to Boston and New York via Amtrak's Acela and the MBTA commuter rail, thanks to its location at the intersection of Route 128 and I-93. The accessibility of the location is further improved by the nearby Norwood Memorial Airport, which offers pilot training and charter services. Desirable features of Westwood include quiet areas, good schools, and continuously high property values. However, promoting inclusive growth and environmental resilience is hampered by the extensive commercial zones and strong reliance on vehicle infrastructure. As a result, Route 128/University Park Station presents a perfect chance to investigate fresh development strategies that appeal to a larger population and promote sustainable expansion. Originally intended to be a stand-alone transit hub, isolated from neighboring neighborhoods and natural areas, the region may develop into a more inclusive and linked place. The development of Route 128 may transform it from a park-and-ride commuter site to a vibrant, coherent neighborhood that would satisfy the evolving demands of a dynamic suburban landscape by incorporating social, economic, and environmental sustainability (Harvard University Graduate School of Design, 2023).

1.2. Urban Agriculture as a Sustainable Design Solution

The sustainability issues brought on by suburban sprawl can be resolved through urban agriculture, which combines social, economic, and ecological advantages (Pearson, Pearson, and Pearson, 2010; Alaimo et al., 2008). In order to improve food security and advance sustainability, this project will build a robust local food system that reduces reliance on long-distance supply chains, utilizing the "farm-to-table" methodology. Incorporating agriculture into suburban landscapes also helps to promote soil health, address unused space, and maintain ecological balance (Lovell and Taylor, 2013).

Suburban areas frequently underutilize local resources, with each suburbanite indirectly consuming large tracts of land while having limited access to productive green spaces. For example, in some suburban contexts, people consume over 31 acres of land, though they only have direct access to less than 5 acres per person (Arnold and Gibbons, 1996). By making better use of these spaces for local food production, urban agriculture can lower transportation-related carbon emissions and improve food traceability (Brown and Jameton, 2000).

Local economics, resilience, and community health have all benefited from urban agriculture (Grewal and Grewal, 2012; Hodgson, Campbell, and Bailey, 2011). A move toward food self-sufficiency is seen, for example, in Massachusetts, where agricultural data indicates a growing desire for locally grown fruits and vegetables. Vegetable and greenhouse/nursery goods output increased in the state's agricultural economy between 2012 and 2017, a sign of growing demand for locally sourced, sustainable food. Urban agriculture and other sustainable techniques offer a chance to lessen ecological footprints while suburban areas continue to face the challenges of sprawl. The goal of this initiative is to create a "local, ethical, and educational agricultural landscape," fostering responsible resource stewardship and reestablishing suburban residents' connection to their environment. Converting areas surrounding transportation hubs—like the area around Route 128/University Park Station—into mixed-use open spaces or agricultural areas can encourage community involvement, draw in a varied population, and help achieve long-term sustainability objectives.

1.3. Research Scope and Methodology

A site-specific design approach is employed to sustainably rehabilitate these areas, addressing the ecological degradation linked to suburban sprawl, since the project focuses on the suburban area along

Route 128 where sprawl has had long-lasting environmental consequences (Daniels, 2011). In order to examine land use distribution, spatial patterns, and the incorporation of green areas, the methodology integrates ecological assessments with GIS mapping (Dietz, 2007; Colding and Barthel, 2013). Important information on biodiversity, water retention, and general ecological health is provided by these evaluations (Jacobson and Delucchi, 2009). According to Mougeot (2006), urban agriculture provides a sustainable framework that complements the project's objectives of developing a resilient, eco-friendly suburban landscape.

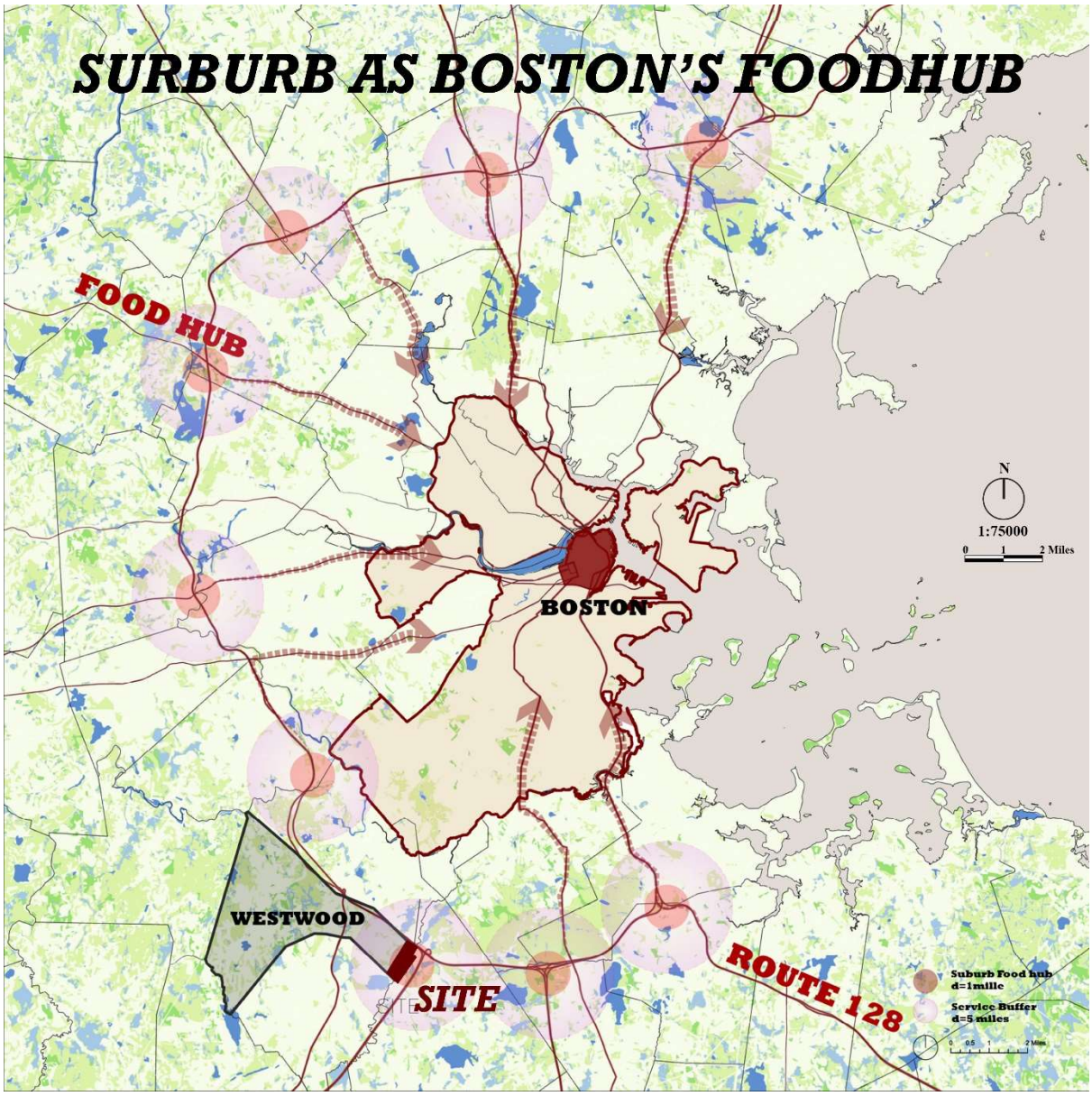

Figure 1. Suburb as Boston's Foodhub. Source: Authors.

The idea offers a thorough plan for Westwood's future growth, with a maximum floor area ratio of 0.4 throughout the property, or about 32,300 square feet (300,000 m²) of usable floor space. The design approach is shaped by several important challenges. First, improving accessibility is essential for promoting a wider variety of lifestyles and serving a diverse population because suburban growth is heavily reliant on

cars. Second, the emphasis on landscape and metropolitan design as defining characteristics of urban form takes precedence over traditional buildings in this lower-density suburban setting. A more landscape-centered approach is made possible by this change, which offers a wider range of design factors to consider. Thirdly, since a large portion of the infrastructure is expensive and outdated, adaptive reuse techniques are given priority, particularly for agricultural facilities. This method meets present and future needs by repurposing existing structures as productive agricultural areas rather than completely rebuilding them. Finally, the homogeneity of experience and lack of programming diversity—two major criticisms of suburban sprawl—must be addressed in new suburban construction. By developing diverse groups and a variety of spaces, this project hopes to foster programming flexibility and adaptability throughout time to meet changing community needs. By using this diverse approach, the project aims to turn the suburban neighborhoods along Route 128 into Boston's Foodhub, a resilient, multipurpose landscape that places an emphasis on ecological health, sustainability, and community inclusivity (Harvard University Graduate School of Design, 2023; Figure 1).

2. Key Design Elements and Implementation Strategies

2.1. Green Space and Impermeable Surface Reduction

With an emphasis on the biological conditions along Boston's Route 128 corridor, the site study highlights important environmental issues seen during a field visit (Figure 2). Three key concerns were emphasized: First, the community's surrounding woodland areas are extremely fragmented, which hinders animal mobility and reduces ecological connectedness. The overall environmental functionality of the area is diminished by this lack of consistency, which impedes wildlife's normal paths. Second, overuse of Asphalt in Car-Oriented Development: The property is mostly covered by asphalt roads and parking lots, much like many suburban areas in the US that are intended to favor automobile access. Because they reduce natural habitats and increase surface water runoff, these non-permeable surfaces have a detrimental effect on the ecosystem. Third, railroad Dividing Wetlands and Dispersing Polluted Runoff: A railroad passes through the area, further dividing vital wetland ecosystems. Furthermore, these wetlands' biological health is deteriorated and pollution is caused by the contaminated runoff from nearby roadways that is directed into them by the uneven topography. These problems are fully addressed in the suggested project. The effort seeks to reduce environmental harm while fostering biodiversity and food security by repurposing the property as a sustainable agricultural hub. Restoring native plant species to improve habitats and ecological stability, enhancing soil conditions and water retention capacity, and substituting farmland and green spaces for paved areas are important steps.

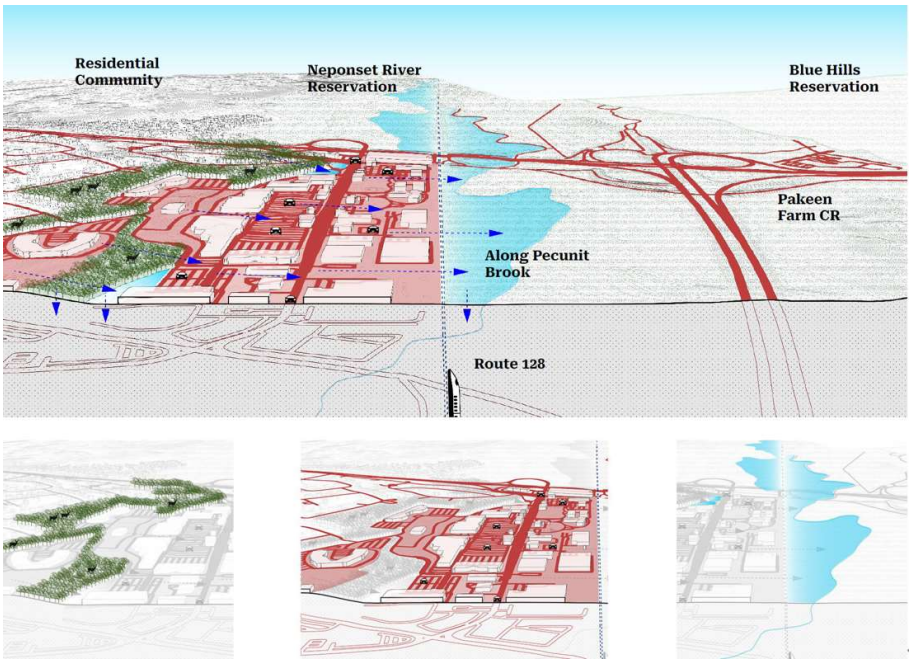

Figure 2. Site Portrait. Source: Authors.

2.2. Community-Driven Food Production and Agrarian Landscape Design

Environmental sustainability, food security, and social cohesion are all improved by local food production. In order to promote community involvement, this project incorporates multipurpose areas with areas set aside for agricultural operations (Twiss et al., 2003; Krasny and Tidball, 2009). Research shows that local aesthetics and public health are enhanced by community gardens (Glover, Parry, and Shinew, 2004). Furthermore, studies by Litt et al. (2015) show that social ties are strengthened and fresh product is more accessible when the community is involved in urban agriculture. This supports the findings of Colding and Barthel (2013), who found that community-driven initiatives boost social and environmental sustainability by fostering resilient urban green spaces (Figure 3).

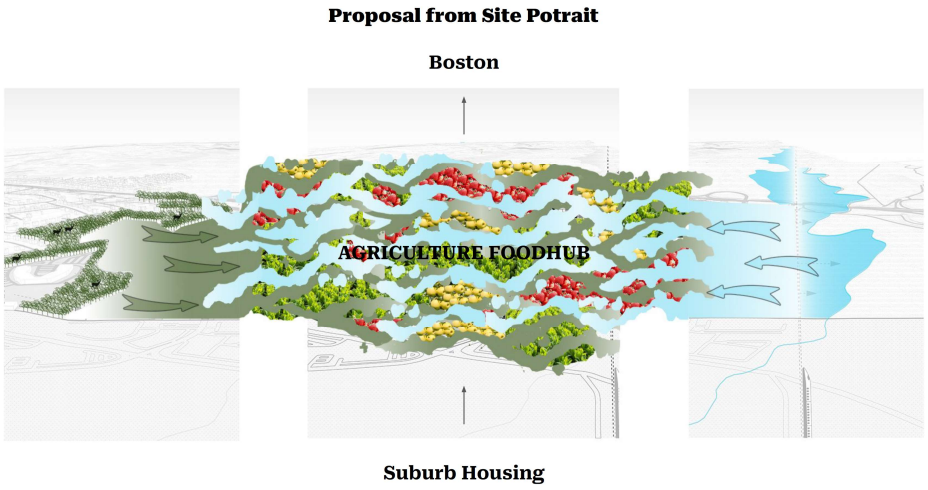

Figure 3. Proposal from Site Portrait. Source: Authors.

Building on this basis, the "Strategic Plan for Crops in Westwood" presents a thoughtfully planned agricultural landscape with native crops including lettuce, carrots, apples, grapes, and green beans that are tailored to Boston's climate and nutritional needs (Figure 4). These crops are dispersed throughout

designated zones, with high-density areas in the center for convenient access and regular harvesting. To strengthen farm-to-table linkages and give the community access to fresh, locally sourced produce, establishments such as a food hub and restaurant are situated close to access points. In order to create a sustainable, culturally integrated agrarian environment that satisfies both ecological and community demands, this strategy maximizes agricultural productivity while encouraging community engagement.

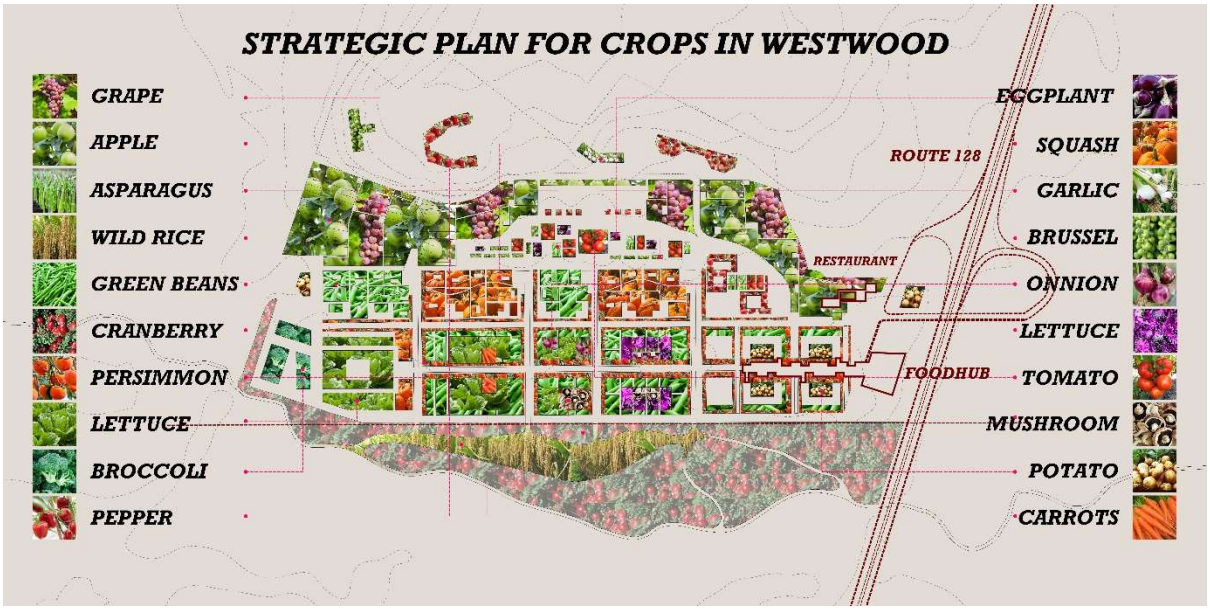

Figure 4. Strategic Plan for Crops in Westwood. Source: Authors.

3. Design Interventions and Future Pathways

3.1. Zoning Strategies

By integrating and balancing commercial operations, agricultural output, and residential community growth, the project's zoning design seeks to create a cohesive, multipurpose environment (Figure 5). Located on the upper part of the property, the Commercial Zone aims to modernize the existing commercial infrastructure while maintaining it in accordance with the project's revised objectives. The commercial zone supports the functional demands and economic vitality of the larger community by maintaining and expanding this region while offering necessary services and amenities. The Agricultural Zone in the center, which is intended to be "One Big Farm," turns existing land into a high-yield farming area that integrates effective water management and sustainability methods. This area creates a continuous green space that provides fresh vegetables, repurposes land for profitable agriculture with an emphasis on water conservation, and improves the ecological health of the region. The Residential & Food Hub Zone, which is located to the right of the plan, combines new housing construction with a central food hub to create a sense of community. By acting as a distribution point for locally grown goods, the food hub strengthens the link between sustainable food sources and urban living by bringing locals and the site's agricultural production into direct contact. This area promotes sustainable living and community involvement with housing that blends in with nearby agricultural areas and enhances the feeling of community.

Figure 5. Master Plan. Source: Authors.

3.2. Adaptive Transformation of Existing Buildings

In order to promote community involvement and maximize agricultural output, this project integrates multipurpose communal areas with an adaptive reuse approach for pre-existing logistical facilities (Figure 6). Important amenities that foster social contact and give community members a place to engage with local food systems include greenhouse spaces, community kitchens, and locations for gathering in shade (Hodgson, Campbell, and Bailey, 2011). Long-term sustainability objectives are supported by this community-oriented design, which cultivates a feeling of shared identity and purpose (Langdon, 2007; Mougeot, 2006). The project also modifies current logistics warehouses to accommodate certain crop light needs, resulting in an agricultural environment that is both productive and climate-sensitive. The project creates "dark greenhouses" for crops that can withstand darkness, like mushrooms, and "bright greenhouses" for plants that like light, like lettuce, by modifying warehouses according to crop requirements. These focused improvements enable for growing a variety of crops without undergoing significant structural changes. The warehouses' high-tech experimental areas also improve the urban farming experience by allowing locals to engage with cutting-edge farming methods and pick crops. Underutilized infrastructure is transformed into productive areas through this integrated approach.

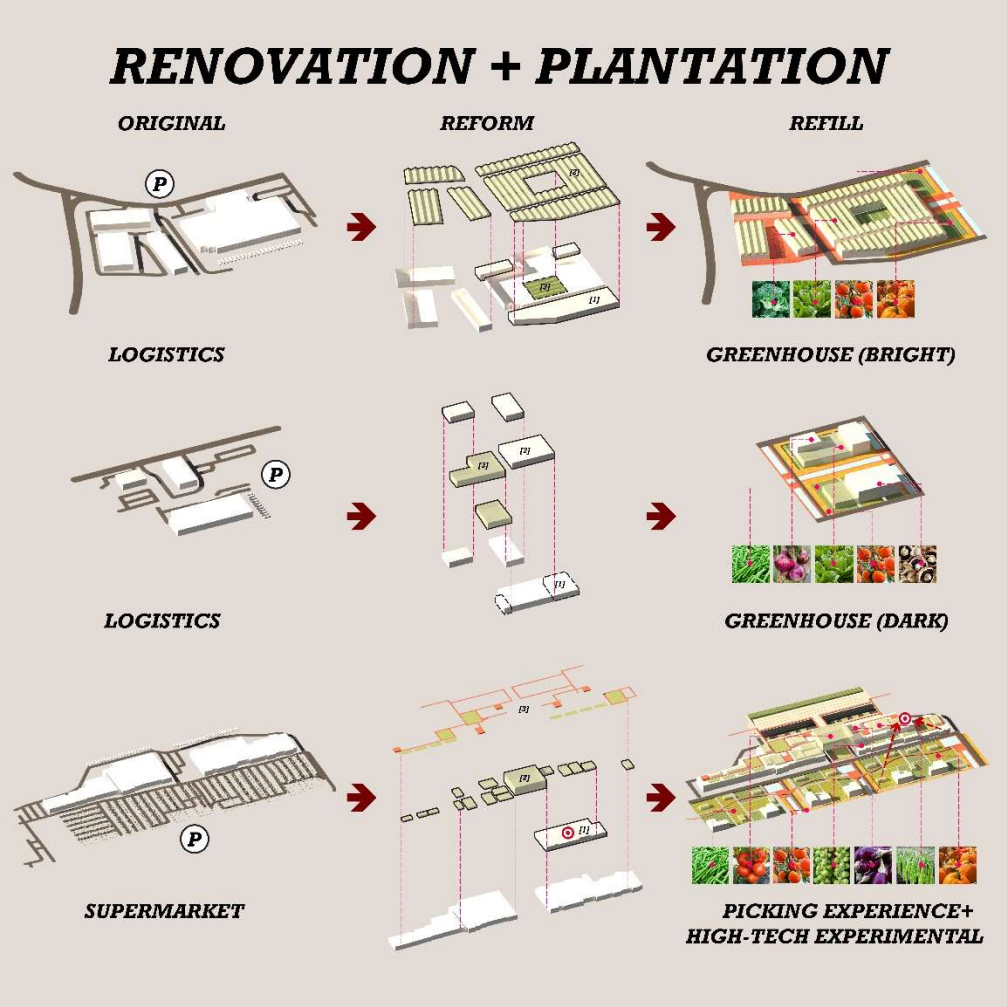

Figure 6. Renovation and Plantation. Source: Authors.

3.3. Time Scope

Using the Route 128/University Park Station district paradigm, this project aims to gradually and phasedly integrate sustainable development and urban agriculture in suburban regions (Figure 7). In phases from 2024 to 2050, the design presents a changing landscape, starting with greenhouses, terraced fields, and experimental agricultural plots. Foundational buildings that serve the residential and agricultural communities, like offices, stores, and garages, are the focus of the early stages. More farming fields, greenhouses, and a food hub will be built by 2030, creating an integrated setting where food production coexists with residences, workplaces, and parks. With each phase improving community engagement with agricultural and sustainable practices, the phased development promotes progressive adaption. More greenhouses, a hospital, and a restaurant will be added by 2040 and beyond, converting the region into a lively, mixed-use location that meets both functional and recreational demands. A self-sustaining community is promoted by the smooth ecological, educational, and social blending made possible by this meticulous design. As different facilities—like residential housing, greenhouses, food centers, and public spaces—are placed throughout the area to maximize accessibility and functionality, the idea of "coexistence and mixing" is essential to this design. Over time, the initiative transforms the suburban

landscape into a multipurpose ecosystem where urban agriculture is integrated into everyday life to promote environmental stewardship, community resilience, and food security.

Figure 7. Incremental and Phasing Plan. Source: Authors.

3.4. Broader Project Impact and Future Development

This project is an innovative approach to suburban sustainability, with broad implications for resource efficiency, adaptive reuse, community engagement, urban-rural connection, and scalable urban design. By using agriculture to rehabilitate suburban sprawl regions like Westwood, the initiative addresses the ecological issues of suburban expansion and creates "middle landscapes" that blend the best aspects of both urban and rural life. This strategy is predicated on the Middle Landscape idea developed by Peter Rowe, which encourages the integration of urban and rural landscapes (Rowe, 1992). Based on the concepts of adaptive reuse (Bullen and Love, 2011), the project aims to repurpose old infrastructure to promote environmental preservation, lessen the demand for new construction, and align with sustainability objectives. This tactic encourages resource preservation, community cohesion, and ecological health. By enhancing natural spaces and minimizing asphalt, the initiative seeks to reduce the carbon footprint typical of suburban areas, so addressing the issues of excessive energy usage and wasted land use. By minimizing the carbon footprint typical of suburban areas through the improvement of green spaces and the reduction of asphalt, the initiative seeks to solve the issues of excessive energy usage and inefficient land use. Community involvement in agricultural activities preserves cultural legacy, improves social ties, and increases environmental awareness by connecting traditional practices to modern ecological solutions for a climate-change-adaptable future. By combining public and educational facilities with agricultural plots, the plan also seeks to create a multipurpose urban region that promotes high-density growth within a flexible grid system. Its success in the Boston area fosters resilient, sustainable suburban development in other places by offering a scalable and flexible model for integrating urban agriculture and adaptive reuse into city planning worldwide.

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4. References

Alaimo, K., Packnett, E., Miles, R.A. and Kruger, D.J. (2008) 'Fruit and vegetable intake among urban community gardeners', *Journal of Nutrition Education and Behavior*, 40(2), pp. 94–101 [online]. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1499404606008542 (Accessed: 17 January 2025).

Arnold, C.L. and Gibbons, C.J. (1996) 'Impervious surface coverage: The emergence of a key environmental indicator', *Journal of the American Planning Association*, 62(2), pp. 243–258 [online]. Available at: https://doi.org/10.1080/01944369608975688 (Accessed: 17 January 2025).

Booth, D.B. and Jackson, C.R. (2007) 'Urbanization of aquatic systems: Degradation thresholds, stormwater detection, and the limits of mitigation', *Journal of the American Water Resources Association*, 33(5), pp. 1077–1090 [online]. Available at: https://doi.org/10.1111/j.1752-1688.1997.tb04126.x (Accessed: 17 January 2025).

Brown, K.H. and Jameton, A.L. (2000) 'Public health implications of urban agriculture', *Journal of Public Health Policy*, 21(1), pp. 20–39 [online]. Available at: https://pubmed.ncbi.nlm.nih.gov/10754796/ (Accessed: 17 January 2025).

Bullen, P.A. and Love, P.E.D. (2011) 'Adaptive reuse of heritage buildings', *Structural Survey*, 29(5), pp. 411–421 [online]. Available at: https://www.researchgate.net/publication/235274709_Adaptive_reuse_of_heritage_buildings (Accessed: 17 January 2025).

Colding, J. and Barthel, S. (2013) 'The potential of "urban green commons" in the resilience building of cities', Ecological Economics, 86, pp. 156–166 [online]. Available at: https://doi.org/10.1016/j.ecolecon.2012.10.016 (Accessed: 17 January 2025).

Daniels, T.L. (2009) 'A trail across time: American environmental planning from City Beautiful to sustainability', *Journal of the American Planning Association*, 75(2), pp. 178–192 [online]. Available at: https://doi.org/10.1080/01944360902748206 (Accessed: 17 January 2025).

Dietz, M.E. (2007) 'Low impact development practices: A review of current research and recommendations for future directions', *Water, Air, and Soil Pollution*, 186, pp. 351–363 [online]. Available at: https://doi.org/10.1007/s11270-007-9484-z (Accessed: 17 January 2025).

Duany, A., Plater-Zyberk, E. and Speck, J. (2000) *Suburban nation: The rise of sprawl and the decline of the American dream*. Illustrated edn. New York: Farrar, Straus and Giroux.

Ferguson, B.K. (1998) *Introduction to stormwater: Concept, purpose, design*. New York: John Wiley & Sons.

Frumkin, H. (2002) 'Urban sprawl and public health', *Public Health Reports*, 117(3), pp. 201–217 [online]. Available at: https://www.researchgate.net/publication/11035517_Urban_Sprawl_and_Public_Health (Accessed: 17 January 2025).

Grammarly (2025) *Grammarly [AI software]*. Available at: https://www.grammarly.com (Accessed: 18 January 2025).

Grewal, S.S. and Grewal, P.S. (2012) 'Can cities become self-reliant in food?', *Cities*, 29(1), pp. 1–11 [online]. Available at: https://doi.org/10.1016/j.cities.2011.06.003 (Accessed: 17 January 2025).

Harvard University Graduate School of Design (2023) *Elements of Urban Design: Fall 2023-2024 STU 1221 Course Syllabus*. Cambridge: Harvard University [online]. Available at: https://www.gsd.harvard.edu/course/elements-of-urban-design-fall-2023/ (Accessed: 17 January 2025).

Hodgson, K., Campbell, M.C. and Bailkey, M. (2011) *Urban agriculture: Growing healthy, sustainable places*. E-book [PDF]. Chicago: American Planning Association. Available at: https://planning-org-uploaded-media.s3.amazonaws.com/publication/book_paperback/PAS-Report-563.pdf (Accessed: 17 January 2025).

Jacobson, M. and Delucchi, M. (2009) 'A path to sustainable energy by 2030', *Scientific American*, 301, pp. 58–65 [online]. Available at: https://doi.org/10.1038/scientificamerican1109-58 (Accessed: 17 January 2025).

Krasny, M.E. and Tidball, K.G. (2009) 'Community gardens as contexts for science, stewardship, and civic action learning', *Cities and the Environment (CATE)*, 2(1), Article 8 [online]. Available at: https://digitalcommons.lmu.edu/cate/vol2/iss1/8 (Accessed: 17 January 2025).

Langdon, P. (1994) *A better place to live: Reshaping the American suburb*. Amherst: University of Massachusetts Press.

Litt, J.S., Soobader, M.J., Turbin, M.S., Hale, J.W., Buchenau, M. and Marshall, J.A. (2011) 'The influence of social involvement, neighborhood aesthetics, and community garden participation on fruit and vegetable consumption', *American Journal of Public Health*, 101(8), pp. 1466–1473 [online]. Available at: https://doi.org/10.2105/AJPH.2010.300111 (Accessed: 17 January 2025).

Lovell, S.T. and Taylor, J.R. (2013) 'Supplying urban ecosystem services through multifunctional green infrastructure in the United States', *Landscape Ecology*, 28(8), pp. 1447–1463 [online]. Available at:https://www.researchgate.net/publication/257504191_Supplying_urban_ecosystem_services_through_multifunctional_green_infrastructure_in_the_United_States (Accessed: 17 January 2025).

Mougeot, L.J.A. (2006) *Growing better cities: Urban agriculture for sustainable development*. E-book [online]. Ottawa: International Development Research Centre. Available at: https://idrc-crdi.ca/sites/default/files/openebooks/226-0/index.html (Accessed: 17 January 2025).

OpenAI (2025) *ChatGPT (Jan 2025 version) [AI software]*. Available at: https://www.openai.com (Accessed: 18 January 2025).

Pearson, L.J., Pearson, L. and Pearson, C. (2010) 'Sustainable urban agriculture: Stocktake and opportunities', *International Journal of Agricultural Sustainability*, 8(1–2), pp. 7–19 [online]. Available at: https://doi.org/10.3763/ijas.2009.0468 (Accessed: 17 January 2025).

Rowe, P.G. (1992) Making a middle landscape. Cambridge: MIT Press.

Shinew, K.J., Glover, T.D. and Parry, D.C. (2004) 'Leisure spaces as potential sites for interracial interaction: Community gardens in urban areas', *Journal of Leisure Research*, 36(3) [online]. Available at: https://doi.org/10.1080/00222216.2004.11950027 (Accessed: 15 January 2025).

Transit Cooperative Research Program (1998) *The costs of sprawl—revisited*. E-book [online]. Transportation Research Board Report 39. Washington, DC: Transportation Research Board. Available at: https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_39-a.pdf (Accessed: 17 January 2025).

Twiss, J., Dickinson, J., Duma, S., Kleinman, T., Paulsen, H. and Rilveria, L. (2003) 'Community gardens: Lessons learned from California Healthy Cities and Communities', *American Journal of Public Health*, 93(9), pp. 1435–1438 [online]. Available at: https://ajph.aphapublications.org/doi/full/10.2105/AJPH.93.9.1435?role=tab (Accessed: 17 January 2025).