Starting the Seeds: An Urban Agriculture Land Inventory in the City of Richmond, Virginia, U.S.A.

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Declarations

During the preparation of this work, the author used *Grammarly* to improve grammar and clarity of writing, *MyBib* to verify citation formats, and *ChatGPT* to check citations.

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Abstract

Urban households in the United States are experiencing a growing crisis of food insecurity. This trend is driven by increasing food prices, limited access to fresh and healthy food, and recent reductions in food assistance programs such as Supplemental Nutrition Assistance Program (SNAP) benefits upon which millions of Americans rely. One potential strategy to address this challenge is urban agriculture (UA), or the cultivation of food within urban environments. This study conducts a land inventory of vacant, abandoned, or "surplus" parcels that may be suitable for urban agricultural production in Richmond, Virginia. Using open-source data, aerial imagery, and Light Detection and Ranging (LiDAR) data, the analysis identifies parcels within the city limits and analyzes their potential for UA based on criteria established by existing literature. The results indicate that opportunities for residential UA exist within the city, particularly in census blocks affected by low food security. These findings provide a foundation for future site selection, as well as for programs and policies aimed at promoting equitable UA in the City of Richmond.

1. Introduction

Cities are currently home to more than 80% of the U.S. population—over 265 million people—representing a 6.4% increase between 2010 and 2020 (United States Census Bureau, 2022). The proportion of U.S. citizens living in urban areas is projected to rise to 89% by 2050 (University of Michigan, 2025). In the face of rapid urbanization, food insecurity in cities is a growing concern. As of 2023, approximately 16% of urban households in the United States were classified as food-insecure, meaning they lacked consistent and reliable access to affordable, fresh, and nutritious food (Rabbitt et al., 2025). At the same time, the United States is becoming increasingly reliant on imported produce. In 2023, approximately 59% of the U.S. fresh fruit supply and 35% of the vegetable supply were imported, and this dependence is expected to grow in the coming years (Williams, 2025). These trends underscore the urgent need for localized, sustainable food systems, positioning urban agriculture as a strong potential strategy for enhancing food security and resilience in rapidly growing urban populations.

Chapter 1 of this paper explores trends and negative outcomes of modern food systems and explores UA as a potential solution. Chapter 2 contains a literature review that examines recent research identifying and analyzing urban land for UA use. Chapter 3 details the methodology of the study, including data sourcing, geospatial processing, and the visualization methods to create the resulting maps. Chapter 4 provides the results and discussion, explores how the results of this project could be used for UA implementation, and evaluates the implications of UA establishment. Chapter 5 draws conclusions, summarizes the findings, and suggests directions for future research.

1.1 Modern Food Systems

Today's food supply chains are more intricate and globally interconnected than ever before (Porkka et al., 2013; MacDonald et al., 2015). The United States is projected to import approximately $212 billion in agricultural products in fiscal year 2025, an increase from $204 billion in fiscal year 2024 (Kaufman, 2025). In 2023, 15–20% of all food consumed in the United States was imported from other countries, a percentage that has doubled since 1993 (Baker, 2025). Imports are especially significant for certain foods—such as seafood, fruits, and vegetables—which often rely heavily on international suppliers to meet U.S. demand.

The reliance of the United States on imported food products can introduce volatility into the food system because it exposes the domestic system to global disruptions. As food supply chains stretch across multiple countries, shocks such as climate extremes, geopolitical tensions, trade restrictions, or transportation bottlenecks can interrupt the flow of goods and rapidly affect availability and prices within the U.S. market. Scholars note that highly globalized food systems are particularly sensitive to external disturbances because production, processing, and distribution are spread across different regions and institutions, making them vulnerable to cascading disruptions (Ingram, 2011; Puma et al., 2015). For example, the International Energy Agency reports that energy expenses—both direct and indirect—such as those tied to oil and natural gas use, can make up as much as 50% of the variable costs of food production in advanced economies like the United States, which in turn contributes to higher food prices (Smith et al., 2025).

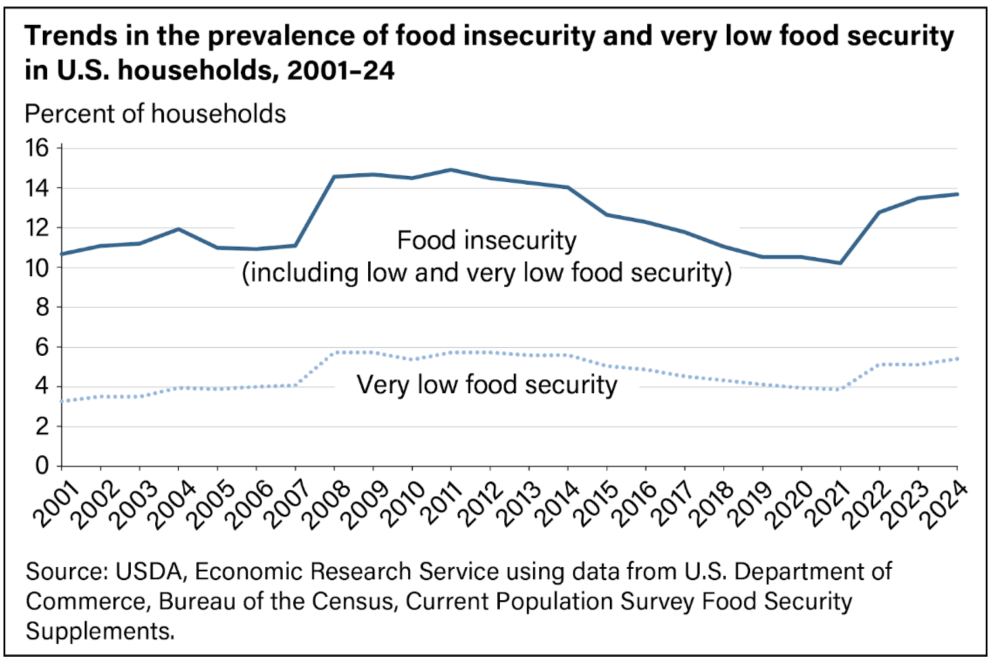
Another vulnerability in our modern food systems is the consolidation of many small or mid-size farming operations into a small number of agricultural firms that supply most of food the nation's food supply. In 1981, the U.S. Civil Rights Action Team warned that government policy in the agricultural sector would shift production toward consolidation, ultimately resulting in the monopolization of the industry by a few large farms (Bergland, 1998). In the decades since, reliance on large-scale, heavily industrialized agricultural operations has grown. Currently, a small share of large-scale farms produces a disproportionate share of U.S. agricultural output (Farm Action, 2024). Industrialized, large-scale agriculture in the United States has enabled high levels of food production, but it also introduces several systemic risks.

Large-scale farming operations often rely on monocultures—growing a single crop over vast areas—which can increase vulnerability to pests, diseases, and extreme weather. When genetic diversity is limited, a single pathogen or climate shock can affect large portions of the food supply, potentially disrupting production and increasing price volatility (Altieri, 1999; Tilman et al., 2002). Another concern is the environmental impact associated with intensive farming practices. Industrial agriculture typically depends heavily on synthetic fertilizers, pesticides, and mechanized equipment, which can contribute to soil degradation, water contamination, and greenhouse gas emissions (Foley et al., 2011). For example, nutrient runoff from fertilizers has been linked to hypoxic "dead zones" in bodies of water such as the Gulf of Mexico, illustrating how agricultural practices can have far-reaching ecological consequences (Rabalais et al., 2002).

American cities are already facing numerous challenges related to healthy, affordable, and reliable food access, even without the threat of events such as climate change, energy shortages, or geopolitical instability (Dave et al., 2024; FAO 2025). As of 2023, 15.9% of urban households in United States principal cities (cities with populations of at least 10,000 residents in the urban core) experienced food insecurity—compared to 13.5% of all households nationally (Suttles & USDA Economic Research Service, 2025). Across the U.S., the proportion of food-insecure households has increased each year since 2021 (Figure 1). Rates of food insecurity also vary across demographic groups; for example, 21% of households headed by a Black individual experienced food insecurity, compared to 8% of those headed by a White individual (Hales, 2024).

Figure 1

Rates of food insecurity in American households, 2001-2024 (USDA ERS, 2026).



Recent reductions in Supplemental Nutrition Assistance Program (SNAP) benefits, combined with government shutdowns, are expected to further increase the number of Americans lacking consistent access to food. A 2022 poll by Michigan State University revealed that 82% of Americans are concerned with rising food costs (Whetstone, 2022). Americans are also experiencing a disconnection from where and how their food is grown and produced. The same study also revealed that 49% of Americans never or rarely seek information about where their food comes from or how it was produced (Whetstone, 2022). A 2022 survey from the University of Minnesota's College of Food, Agricultural and Natural Resource Sciences (CFANS) showed that only 24% of U.S. adults have a "high degree of trust" in the information they receive about where their food is grown and how it is produced (University of Minnesota, 2022).

Vegetable consumption in U.S. cities remains below USDA recommendations and has steadily declined over the past two decades, particularly among socioeconomically disadvantaged, rural, and low-income populations (Kantor & Blazejczyk, 2021). Although federal dietary guidelines recommend that adults consume about 1.5–2 cups of fruit and 2–3 cups of vegetables daily, most Americans fall well short of these targets. According to a report from the Centers for Disease Control and Prevention (CDC), only about 12.3% of U.S. adults met the recommended fruit intake and roughly 10.0% met the recommended vegetable intake in 2019, with the average frequency of consumption remaining low across states and demographic groups (Lee, 2022).

Many Americans face significant health problems linked to poor dietary patterns. Diets high in sodium, added sugars, and processed foods—along with low intakes of fruits, vegetables, and whole grains—are estimated to contribute to nearly half of deaths from cardiometabolic diseases (such as heart disease, stroke, and type 2 diabetes) (National Institute of Health, 2017). Obesity affects over 40% of U.S. adults and increases the risk of type 2 diabetes, hypertension, coronary heart disease, certain cancers, and other chronic illnesses (Centers for Disease Control and Prevention, 2024). Poor dietary habits, including the high consumption of ultra-processed foods and added sugars, further drive weight gain, metabolic dysfunction, and inflammation, which exacerbate chronic disease risk (American

Heart Association, 2021; AP News, 2023). These patterns indicate a strong connection between modern American diets and the nation's chronic disease burden, showing a persistent gap between nutritional recommendations and dietary behaviors (NHLBI, 2019).

1.2 Urban Agriculture as a Solution

Our current food crisis is not inherently negative. Crises often drive transformation, and such change is already underway as our current food system proves unsustainable in the long term. This moment of crisis represents "a time of opportunity — a critical time and state of affairs that will make a decisive difference, either for better or for worse" (Ikerd, 2008, p. 4). One promising approach to strengthening the resilience and long-term sustainability of food systems is UA. The United States Department of Agriculture (USDA) defines urban agriculture as "the cultivation, processing, and distribution of agricultural products in urban and suburban areas" (USDA, n.d.). Zumkehr and Campbell (2015) suggest that as much as 90% of the food needed by urban populations in the United States could theoretically be produced on land located within 100 miles of city centers. Already, urban areas play a significant, often overlooked, role in food production (Smit, 1996).

UA has gained increasing attention as a strategy to mitigate food deserts by enhancing access to fresh, nutritious food within underserved urban communities. Food deserts—areas with limited access to affordable, healthy food outlets—are linked to higher rates of diet-related diseases and food insecurity among low-income populations (National Research Council (US), 2009). UA interventions can address these disparities by providing residents the ability to grow fresh, quality produce directly within or near food-insecure neighborhoods (Siegner et al., 2018).

Research shows that converting vacant urban land into sites for local food production increases availability of fresh fruits and vegetables in areas that otherwise lack grocery stores, helping to mitigate the spatial dimensions of food deserts (Tong et al., 2020). For example, empirical spatial analyses demonstrate that community gardens can increase access to healthy foods within identified food deserts, particularly when integrated into broader urban food systems (Wang et al., 2014). In addition to food access, UA fosters community engagement and resilience, providing spaces where residents can grow, share, and distribute produce. Systematic reviews highlight community gardens' contributions to food security and urban resilience by offering food access points, strengthening social networks, and reinforcing local capacity to produce and distribute healthy food in low-income neighborhoods (Huq & Deacon, 2025).

UA can help address other persistent urban challenges such as social inequalities, health disparities, and scarcity of green spaces in cities (Mead et al., 2024; Thwaites et al., 2025). There are many long-standing examples of successful and widespread UA practices by individuals and communities in American cities. Within the United States, some UA success can be attributed to migrant residents bringing agricultural practices and plant varieties from their country of origin (Onyango et al., 2025), or indigenous communities seeking to maintain their agricultural and cultural traditions (Buhrmaster, 2024; Fisher, 2022). Black Americans have used UA as a means of establishing just and equitable food systems in cities that have historically enacted discriminatory planning policies and underinvested in these communities (Taylor & Lovell, 2012).

Beyond the capacity to improve food access and urban food security, UA provides a wide array of ecosystem services, including provisioning services (e.g., supplying high-quality, fresh food to urban populations) and supporting services (Newell et al., 2022). It can also enhance regulating services by reducing emissions associated with "food miles"—the environmental costs of transporting food across long distances (Weber & Matthews, 2008). Localizing food production diversifies the food system and mitigates vulnerabilities in global supply chains, insulating them from disruptions such as fuel price fluctuations, natural disasters, and climate change. Furthermore, UA contributes cultural services by providing recreational spaces, environmental education opportunities (Camps-Calvet et al., 2016), and fostering social cohesion and community building (Guitart et al., 2012).

Promoting equitable access to food, sustainable land use, and climate-resilient urban planning aligns with several United Nations Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger), Goal 11 (Sustainable Cities and Communities), and Goal 13 (Climate Action) (UN Environment, 2015). The World Health Organization identifies four main pillars of food access: physical availability of food, economic and physical access, food utilization (including diet diversity, feeding practices, and food preparation), and the stability of these three dimensions over time (FAO United Nations, 2008). UA can enhance each of these pillars and can be strategically implemented in food-scarce localities to mitigate food insecurity.

At present, grassroots UA initiatives are advancing more rapidly than policy, both within the United States and internationally. Within the U.S., existing UA policy frameworks are shaped by federal guidance, state-level initiatives, and local regulations. At the federal level, agencies like the United States Department of Agriculture (USDA) support urban farming through grant programs, technical assistance, and food access initiatives, particularly under programs such as the Urban Agriculture and Innovative Production (UAIP) initiative.

However, cities and counties hold most regulatory authority over land use, zoning, and local food production. Local zoning ordinances permit community gardens, rooftop farms, and even small-scale livestock in certain districts. As a result, urban agriculture policies vary widely across jurisdictions, reflecting local priorities around food security, economic development, environmental sustainability, and community health. Within Richmond, UA is heavily influenced by zoning codes, which are beginning to recognize agriculture as legitimate urban land use. Recent drafts to zoning ordinance updates include categories of “urban gardens” and “indoor growing systems” (City of Richmond, Virginia, 2025).

In recent years, localized food production has been increasingly recognized in academia as a vital strategy for improving food security (Zumkehr & Campbell, 2015). The body of literature related to UA study is expanding. Researchers have examined the possibilities for expanding agricultural production in several U.S. cities, such as Oakland (McClintock et al., 2013), Portland (Balmer et al., 2005), Seattle (Horst, 2008), Chicago (Taylor & Lovell, 2012), New York (Ackerman et al., 2014), and Phoenix (Aragon et al., 2019). Ackerman et al. note that UA should be pursued because it “touches on the three pillars of sustainability: economics, society, and the environment,” which are all critical for a sustainable future (p. 190).

However, UA is not inherently just and must be approached carefully–if not approached with explicit goals of equity, it has the capacity to further perpetuate social, economic, and political inequalities that exist in most American cities (Horst, 2017). This is why spatial assessments of potential UA are so important–they allow for the incorporation of socioeconomic factors and measures of accessibility to ensure that the benefits of UA are received by those who need it most.

1.3 Defining Urban Agriculture

To assess the use and effectiveness of UA, the concept must first be clearly defined. Most definitions of UA consider two primary factors: the population density that qualifies an area as "urban" and the type of activity that can be classified as agriculture. Urban classifications vary widely by country. According to the United States Census Bureau, an urban area is defined as "a contiguous grouping of census blocks, each with a population density of at least 500 people per square mile, with a total population of at least 50,000 people" (U.S. Census Bureau, 2016). Wagstaff and Wortman define UA as "all forms of agricultural production (food and non-food products) occurring within or around cities" (Wagstaff & Wortman, 2013, p. 8).

In the United States, the federal government established the USDA Federal Advisory Committee for Urban Agriculture and Innovative Production in 2022 under the 2018 Farm Bill. The Bill also created an Urban Agriculture and Innovative Production Advisory Committee and granted the USDA authority to fund UA development and pilot projects in counties with high UA concentrations (Agriculture Improvement Act, 2018). One example is the American Planning Association, supported by the Agriculture and Food Research Initiative (AFRI) Food Systems Program grant, which publishes guides to assist with planning local urban food production.

UA encompasses a wide range of production methods and business models, including for-profit ventures, non-profit operations, community-led initiatives, or combinations thereof

(Little, 2021). For-profit farms may operate through Community Supported Agriculture (CSA) programs, in which customers pay for a share of the harvest. Work-share gardens provide produce in exchange for labor, while members of community gardens may pay fees for individual or shared plots. UA also includes individual efforts, such as backyard gardens, vertical gardens, or school and assisted-living facility gardens. UA can include a variety of methods (e.g., traditional farming, hydroponics, and rooftop gardens) and purposes, such as personal consumption or commercial sales.

Government agencies and peer-reviewed literature often use the term “urban gardening” to describe UA production for personal use, while “urban farming” typically refers to UA intended for commercial sale. The USDA defines a farm as “any place that produced or sold—or normally would have produced or sold—at least $1,000 of agricultural products in a given year” (Hoppe & MacDonald, 2013, p. 2). Agricultural operations that do not meet the $1,000 threshold but have the potential to do so are sometimes classified as point farms (Hyman & Young, 2016). Farms are subject to additional regulations, taxes, and liability compared with non-farm agricultural operations (Little, 2021).

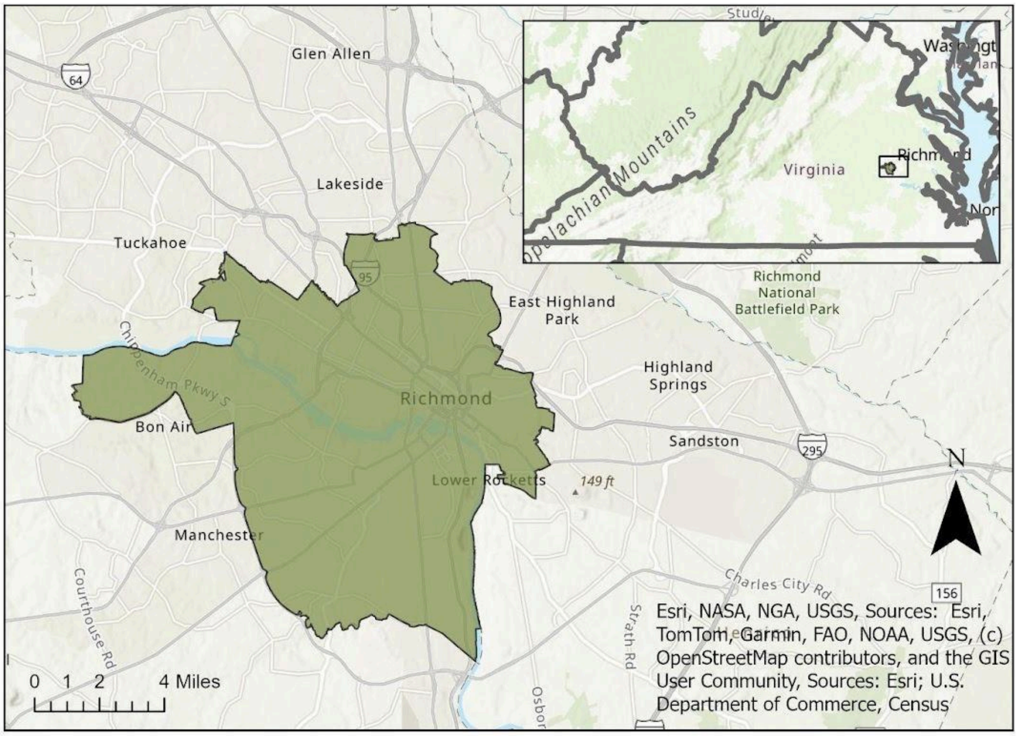
1.4 Objectives of this Project

How can informed decisions be made to successfully and equitably establish and support agriculture in an urban landscape? This project develops a “Land Inventory” of potential sites within the City of Richmond, Virginia, intended to serve as a foundation for future site evaluation and selection for UA projects. To achieve this, the study applies a criteria framework using GIS techniques to vacant or unused parcels of land within the city limits. The land inventory focuses on unused, abandoned, or vacant properties within the City of Richmond. The inventory is designed to researchers, community organizations, governments, and residents the ability to incorporate additional data and stakeholder input, allowing site suitability to be refined based on the specific goals of individual UA initiatives. The project produces a list of parcels that meet criteria for UA use based on parameters commonly cited in the UA literature. The assessment assumes that land has the potential for agricultural production if it meets the suitability criteria included in the analysis. All data used in the analysis were clipped to the City of Richmond boundary TIGER/Line Shapefile obtained from the U.S. Census Bureau website.

This inventory serves as a basis for future site evaluation and lays the framework for Multi-Criteria Evaluation (MCE) to meet community-specific needs and goals. Key objectives include the identification of land criteria required for UA, screening of available parcels that meet chosen criteria, and the identification of suitable parcels located in areas of low food access.

Figure 2

City boundaries and location of Richmond, Virginia, U.S.A.



2. Literature Review

Until a few decades ago, scholarship on UA remained limited, contributing to a lack of comprehensive urban planning policies to support its development in the United States (Audate et al., 2019; Pothukuchi & Kaufman, 2000). As a result, practice has often outpaced policy, with individuals and local communities leading the development of best practices for UA in American cities. Kamali (2025) argues that research on urban agriculture and food security can be broadly categorized into three approaches. The first evaluates the capacity of urban land to support food production. The second examines the outcomes and community impacts of specific gardening or farming initiatives. The third critically assesses how UA can be advanced without reproducing existing social and spatial inequities.

Together, these approaches provide a comprehensive foundation for understanding urban agriculture and for guiding its implementation in ways that achieve intended goals while maximizing benefits for urban residents. The following literature review focuses on studies within the first approach, specifically those that identify and analyze methods for evaluating urban land suitability for UA.

Site assessments, typically conducted within city boundaries or other defined urban areas, aim to identify and evaluate the suitability of land parcels for UA. The criteria used in spatial assessments vary according to specific objectives, which in turn shape decisions related to site selection, crop choice, and cultivation methods. The goals of UA spatial assessments are diverse. They can include addressing gaps in the spatial distribution of existing UA sites (Meenar, 2017); targeting socioeconomic inequality (Kamali et al., 2025); and improving public health outcomes in areas with high levels of diet-related diseases in residents (Audate et al., 2019; Mack et al., 2017). Some analyses seek to minimize environmental and public health risks associated with food production in urban settings (Kazemi & Housseinpour, 2022). Health risks of UA can be caused by poor air and water quality, as well as soil contamination, which are common in urban environments. Other goals of UA spatial assessments are maximizing the food production capacity of cities (McClintock & Cooper, 2010; Taylor & Lovell, 2012).

UA site analyses employ a diverse range of methods to identify suitable locations for implementation. The choice of method is typically guided by the specific objectives of the analysis, the availability and quality of data, and the environmental, social, and political contexts of individual cities. Common approaches include geographic information systems (GIS)-based analysis, multi-criteria decision analysis (MCDA), spatial optimization and decision models, or various combinations of these techniques.

2.1 Defining the Area of Study

The first step in surveying land for potential UA sites is defining the area of study. Most studies use municipal boundaries to delineate the area assessed for UA (Fun et al., 2024; McClintock, 2013; Newell et al., 2022; Thapa et al., 2021) This approach tends to provide a clear, administratively straightforward framework, as most data is collected and organized by city or census tract. Furthermore, zoning laws, land banks, and permitting processes are typically run by municipalities, simplifying the implementation practices of UA within a particular city.

However, some studies define urban areas more precisely within and beyond city boundaries, often relying on the U.S. Census Bureau's definition of an "urbanized area:" an area with at least 5,000 residents or 2,000 housing units (U.S. Census Bureau, 2024). There can also be differentiation between “urbanized cores” (contiguous areas meeting urban thresholds) and “urbanized clusters” (noncontiguous areas meeting urban thresholds) (Young et al., 2018).

Studies can also focus specifically on the rural-urban “fringe” of land within a reasonable travel distance to the city (Bayr et al., 2025; Hastings et al., 2025; Mack et al., 2017). This is sometimes referred to as peri-urban agriculture (UPA). UPA and UA can be combined with urban areas to broaden the area of assessment and increase land availability. In some cases, peri-urban land yields higher suitability scores than urban land for agriculture (Kazemi & Housseinpour, 2022). The United States Census Bureau’s Urbanized Area and Urban Cluster datasets enable the identification of urban and peri-urban areas due to their finer spatial scale (Ratcliffe et al., 2016). Some of the benefits of considering UPA are less stringent zoning restrictions than those in urban areas (Mougeot, 2000).

While UPA approaches increase the quantity and sizes of suitable UA sites, they also require urban residents to have means of accessing UA sites (public transportation, vehicle access), if they are to practice UA. Establishing UA in the less densely-populated rural-urban fringe can create accessibility barriers for groups that would benefit the most from UA (such as low-income residents) (Žlender et al., 2017). Due to the importance of accessibility for an equitable UA approach, many UA spatial analyses include parameters of accessibility as a criterion (Kamali et al., 2025). Studies that focus on production capacities of areas outside city limits or in lower-density areas often have goals of enhancing local agricultural businesses and for-profit food production rather than establishing UA sites for use by residents (Kamali et al., 2025; Bayr et al., 2025).

In light of new technological advances and growing techniques, some studies also focus on the potential of rooftops and building facades, citing rooftop UA infrastructure involving substrate barriers and drainage barriers (Aragon et al., 2019). Improvements to cultivation practices, such as soil amendments, expand possibilities for what was previously considered unfarmable land (Kamali et al., 2025).

2.2 Land Inventory

After establishing an area of study, UA land suitability analyses conduct a "land inventory" within the defined study area. Researchers compile data from a variety of sources, including web scraping (Young et al., 2018), tax records (Balmer et al., 2005), remote sensing (Taylor, 2012), aerial imagery (Newell et al., 2022), and voluntary reporting (GreenNet, 2011). In some cases, sites identified through these methods are further examined using aerial imagery or ground-truthing to confirm vacancy (McClintock et al., 2013).

A key challenge for UA is identifying land within cities that is both available and suitable for agricultural activities. To address limited land availability in urban areas, land inventories commonly focus on vacant or abandoned parcels (Colasanti, 2010; Kamali et al., 2025; Rib et al., 2020). Studies examining unused or vacant land typically rely on databases of abandoned, vacant, or underutilized properties—both publicly and privately owned—often obtained from local government records. This approach is particularly common in cities where vacant land is widespread. Targeting vacant land can also help address issues associated with urban blight, such as declining property values and health and safety concerns (Newell et al., 2022). In several United States cities—including Baltimore, Philadelphia, Cleveland, and Detroit—communities have established networks of gardens and urban farms in previously abandoned and derelict land to increase green space and help combat urban blight (Newell et al., 2022).

Some studies focus on publicly owned "unused" or underutilized spaces in urban areas rather than privately owned vacant or abandoned properties. For example, McClintock & Cooper (2013) used GIS, local tax assessor data, aerial imagery, and ground-truthing to systematically identify "fallow, vacant, or unused commons" owned by government agencies—including municipal, county, regional, state, and federal entities—with potential for cultivation. Similarly, Balmer et al. (2005) surveyed properties managed by the Bureaus of Environmental Services, Parks and Recreation, Transportation, and Water, which provided the research team with data on 875 individual sites. Horst (2008) also included public schools and parks in an evaluation of land suitable for UA in Seattle, Washington. In studies such as these, researchers include or restrict their analyses to land owned or managed by local government entities, sometimes in collaboration with those agencies. This approach can facilitate access to data and institutional support and may also simplify the implementation of UA initiatives.

Other studies focus include residential land as part of their targeted area of study, with the goal of implementing UA on the residential level (Kremer & DeLiberty, 2011). While residential land can expand the available urban land for UA, it requires that participants of UA have both (a) have access to a residential yard and (b) can modify their yard to support agricultural activity. Using this model, urban residents without access to a private yard cannot participate in urban agriculture, which would create a barrier to those who live in apartment buildings or condominiums. Furthermore, residents who rent their homes may not be permitted to modify the yard of their rental property and would therefore be restricted from participating in urban agriculture under this approach.

2.3 Criteria Selection and Application

2.3a Physical Site Characteristics

Next, parcels generated from the previously mentioned methods are filtered and screened for characteristics that can support UA. Criteria typically informed by existing literature on ideal land characteristics for traditional agriculture as well as the goals of the study. For physical site criteria, sites are commonly assessed for slope (minimum slope to minimize erosion and maximize irrigation efficiency) and size (minimum suitable size for agriculture). The maximum suitable slope for planting is generally 15-20%, although this can vary depending on the type of cultivation (United States Department of the Interior, 2006). Fun et al.'s (2024) assessment of sites for UA implementation in Oakland, California, used criteria of a slope less than 15% and minimum parcel size of 4,000 ft^2. These parameters are accepted and used by multiple UA studies (Kamali et al., 2025; Kremer & DeLiberty, 2011).

Hastings et al. (2025) used Land Evaluation and Assessment (LESA), which combines variables such as soil productivity, aesthetic values, and non-agricultural developmental pressures, to determine suitability of land for long-term agricultural use. Other studies incorporate land use as a criterion to determine the current status of the proposed site (residential, commercial, vacant, etc.) (Kamali et al., 2025). Ground cover is another common criterion to assess suitability for UA. Newell (2022) used imperviousness of ground cover as a criterion in a UA site evaluation to maximize ecosystem services associated with UA.

2.3b Infrastructure and Accessibility

Kamali et al. (2025) used parameters of walkability, proximity to roads, and proximity to high-density housing as a means of evaluating UA sites with an equity-based approach (Kamali, 2025). Access is an important consideration, especially if the goal of the study is to address food scarcity in urban areas where residents may not have access to a vehicle and/or may use alternative forms of transportation, such as bikes or public transportation. Other parameters relating to accessibility include percentage of residents owning a vehicle and distances to grocery stores (Thapa et al., 2021). Even studies intending UA to function as a for-profit business prioritize shorter distances from the urban core as a means of minimizing transportation costs for farmers (Bayr et al., 2025; Kremer & DeLiberty, 2011).

Suitability of parcels can also be assessed through proximity to relevant infrastructure for UA. Rib et al. (2020) defined "high suitability" parcels by those with close proximity to other suitable parcels, fire hydrants, water wells, and residential centers. Other studies use distance from existing gardens as a means identifying how to best distribute potential sites within the city (Newell et al., 2022).

2.3c Environmental Health Parameters

Some studies filter out sites that carry environmental and health risks due to soil testing results, proximity to superfund sites or roadways, or other risk factors. Longcore et al. (2011) eliminated areas subject to contamination from freeway pollution, near gasoline service stations, Superfund sites, or sites in the Toxic Release Inventory (TRI). Kazemi & Housseinpour (2022) identified and measured urban pollutant levels (lead, zinc, and nitrogen) to determine site suitability with goals to minimize environmental risks associated with growing food in an urban environment. Other studies use health parameters to assign higher suitability scores in areas with higher rates of diet-related diseases. Kamali et al. (2025) used obesity as a criterion for UA site analysis in Birmingham, Alabama.

2.3d Economic Parameters

Many researchers incorporate economic data into their land analyses to determine which residents are most in need of the economic benefits provided by UA. Some economic parameters include the proportion of households in poverty (Thapa, 2021), median home values (Mack et al., 2017), the proportion residents on food stamps (Mack et al., 2017), or the proportion of residents without healthcare (Mack et al., 2017).

There are many well-supported and consistently used criteria across UA literature to identify parcels best suited for UA. The selection and weighing of additional criteria, such as those related to population characteristics or the availability of infrastructure, are often informed by the unique landscape of the urban environment and the goals of the study. Many criteria are also informed by stakeholder input and preliminary studies on core problems faced by the urban area of study.

2.4 MCDA Site Analysis

Many spatial analyses of potential UA sites rank locations identified through land inventories by applying weighted evaluation criteria. This is commonly achieved using multi-criteria decision analysis (MCDA) in combination with GIS, which together enables the integration of spatial, environmental, and socio-economic data to assess site suitability. GIS enhances MCDA by facilitating the visualization and layering of criteria, improving interpretation of spatial trade-offs (Malczewski, 2006). Although MCDA was not applied in this study due to the precedent of stakeholder input to define and weight criteria, it remains a widely used approach in UA planning and warrants discussion.

MCDA encompasses structured methods for evaluating alternatives across multiple, often competing criteria. These approaches support transparent and systematic decision-making by incorporating both quantitative and qualitative factors (Belton & Stewart, 2002; Triantaphyllou, 2000). In UA planning, MCDA is particularly valuable for balancing environmental suitability with social considerations such as accessibility and equity (Lovell, 2010). Common MCDA techniques include the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and the Analytic Hierarchy Process (AHP).

TOPSIS ranks alternatives based on their proximity to an ideal solution and distance from a worst-case scenario (Hwang & Yoon, 1981). In UA site selection, it evaluates locations against normalized criteria to identify those most closely aligned with optimal conditions. The method is relatively straightforward and effective for quantitative data, allowing comparison of both beneficial and non-beneficial criteria. However, it is sensitive to normalization procedures and less suited to incorporating qualitative judgments or complex stakeholder preferences. For example, Bayr et al. (2025) applied GIS-based TOPSIS to identify suitable UA sites in Norwegian cities, producing spatial suitability maps that highlighted underutilized areas with high potential for agricultural expansion.

AHP, by contrast, uses pairwise comparisons to derive weights that reflect expert or stakeholder priorities (Saaty, 1980). It is well-suited to UA planning because it can incorporate qualitative criteria, including social and accessibility factors, alongside environmental variables. Its ability to capture stakeholder input is a key strength, particularly given the importance of community context in UA success (Opitz et al., 2016). AHP also includes a consistency check to improve reliability (Saaty, 2008), though it can become complex and subjective as the number of criteria increases. Applications such as Smith et al. (2021) demonstrate that including social variables like food access can significantly influence site selection outcomes.

GIS–AHP frameworks are frequently used to improve transparency in planning processes. For instance, Kazemi and Hosseinpour (2022) combined AHP with GIS and expert input as a method of urban planning in Mashhad, Iran. Because AHP produces criterion weights rather than final rankings, it is often paired with methods like TOPSIS. Hybrid approaches, where AHP determines weights and TOPSIS ranks alternatives, allow both qualitative judgments and quantitative evaluation to inform decision-making (Ustaoglu et al., 2021). The choice of method ultimately depends on data availability, stakeholder involvement, and the complexity of the study area.

Overall, GIS-based MCDA methods provide a comprehensive framework for evaluating UA site suitability by integrating diverse criteria into a transparent decision-making process. Their widespread use reflects the complexity of urban food system planning and the need to balance environmental, spatial, and social considerations. However, their effectiveness depends on meaningful stakeholder participation, which shapes both the selection and weighting of criteria. While MCDA was not applied in this study, understanding these approaches is important, as they offer valuable insight into how UA sites can be systematically prioritized to support more accessible, equitable, and sustainable urban agriculture systems.

3. Methodology

3.1 Study Area

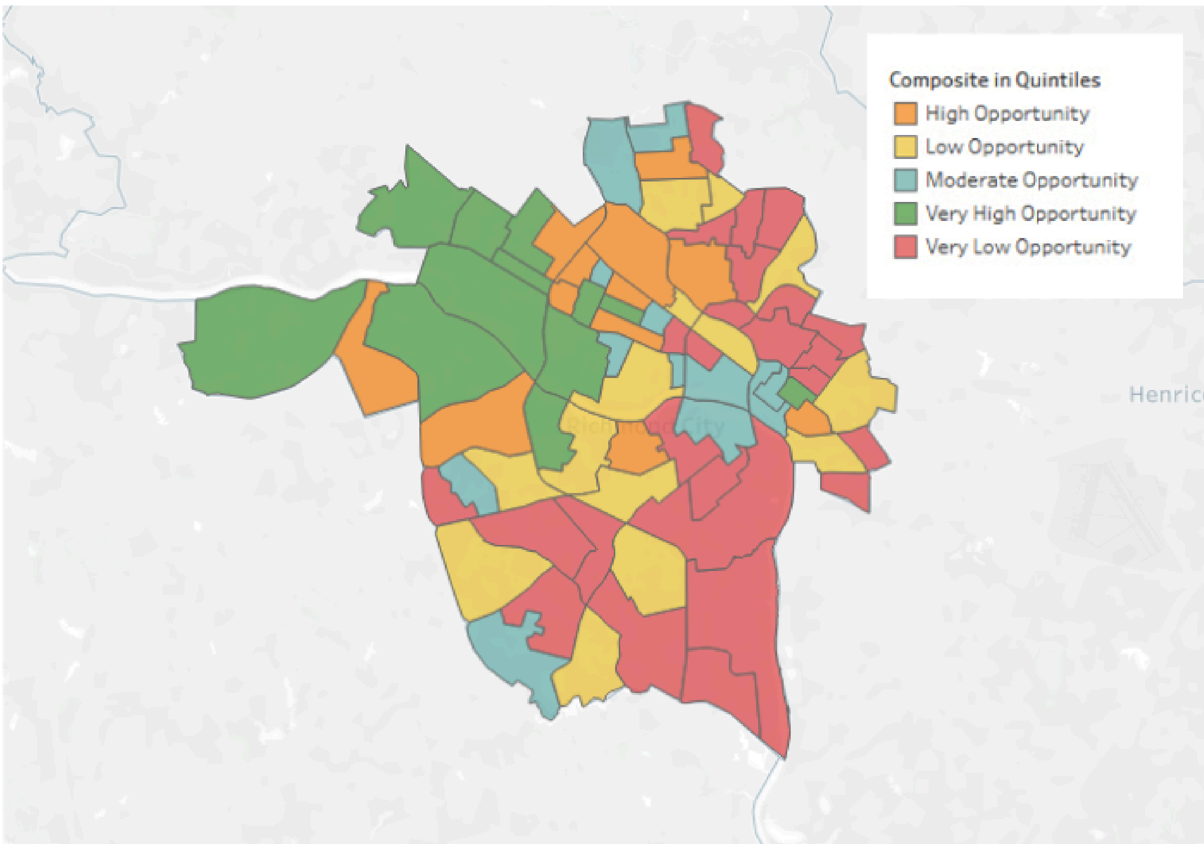
The study area included the entirety of the City of Richmond, Virginia, U.S., which totals 62.6 mi^2. Richmond, Virginia, is located in the eastern-central part of the state. It sits on the fall line of the James River and borders the surrounding counties of Henrico County and Chesterfield County. In recent years, the City of Richmond has experienced significant population growth, increasing by 11% within the past 10 years and projected to increase another 18% increase by 2050 (The Economic Development Authority of the City of Richmond, 2026).

Richmond has a long history of racially discriminatory urban planning policies, ranging from redlining to chronic underinvestment in predominantly Black and low-income neighborhoods. The construction of Interstate 95 through the city bisected the historic, predominantly Black neighborhood of Jackson Ward, resulting in physical division, property destruction, and long-term economic stagnation. Today, significant urban heat island effects have been documented in Richmond, with heat emergencies disproportionately affecting Black and low-income residents of Richmond (Braun et al., 2024; Eanes et al., 2020).

According to the Virginia Department of Health's Health Opportunity Index (HOI), there is a wide disparity in health opportunity scores across Richmond (*Figure 3*). The Health Opportunity Index is composed of 30 variables, including food accessibility, income inequality, walkability, and housing affordability (Virginia Department of Health – Office of Health Equity, 2023). In Richmond, 14.7% of residents experience food insecurity, while the rate among children is 21.5%, compared to a statewide average of 10% in Virginia (FoodBankFinder.net Research Team, 2025).

Figure 3

Health Opportunity Index Scores by Census Tract in the City of Richmond, Virginia (Virginia Department of Health – Office of Health Equity, 2023).



Although Virginia's median household income ($92,090) exceeds the national average of $81,604, the median income of Richmond residents was $64,587 in 2024, falling below the statewide average (United States Census Bureau, 2025). A similar pattern appears in poverty rates: the statewide poverty rate in Virginia was 9.1%, whereas Richmond's poverty rate reached 18.2% (compared to the national poverty rate of 12.1%) in 2024 (United States Census Bureau, 2025).

Limited food access is also a challenge for many communities in Richmond. The U.S. Department of Agriculture's Food Access Research Atlas identifies a high proportion of city census tracts as experiencing both low income and limited access to full-service grocery stores (United States Department of Agriculture, 2025).

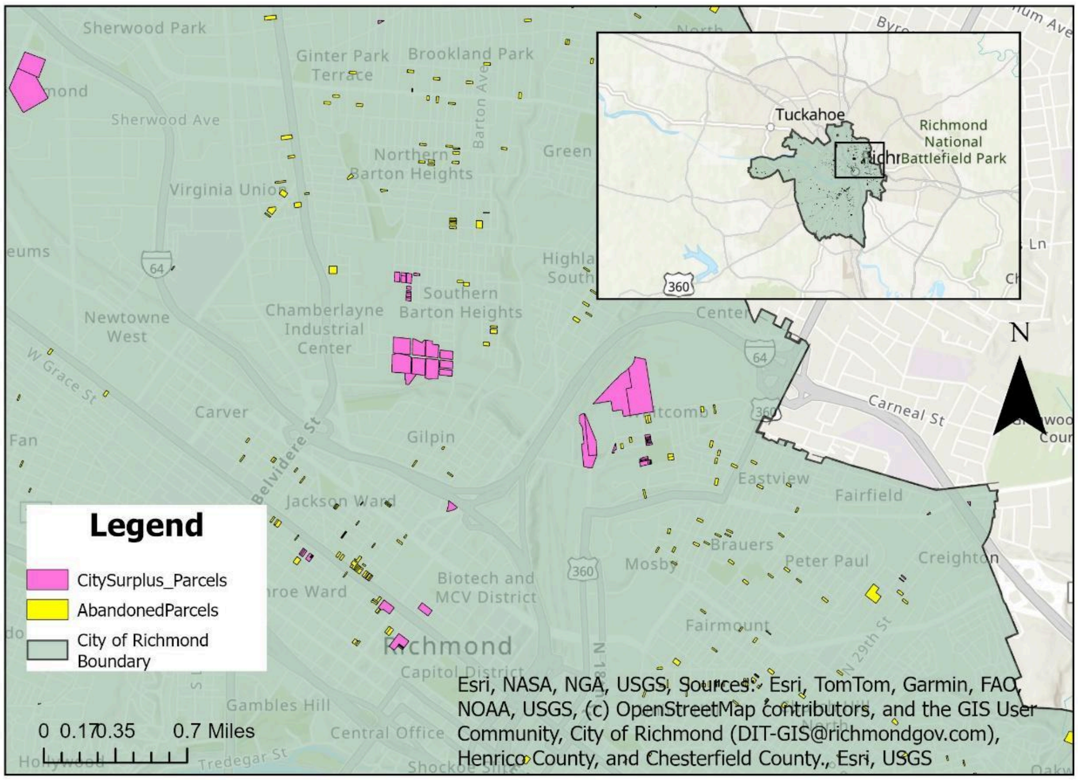
Several existing policies and programs promote UA in the City of Richmond, Virginia. The "Richmond Grows Gardens" program provides guidance for residents and organizations seeking to establish community gardens on city-owned land through a permit system, helping convert designated parcels into spaces for growing produce. These efforts are supported by broader municipal initiatives, including the city's sustainability agenda and the "RVAGreen 2050" plan, which calls for the development and funding of urban and community agriculture programs as part of Richmond's broader environmental and climate goals (RVA.gov, 2026).

3.2 Criteria Selection and Application

Two primary datasets were used to compile the initial inventory. The first dataset consists of privately owned properties classified as "abandoned," obtained from the City of Richmond's public data portal (Rva.gov, 2025). Properties are included in this registry when they have been uninhabited for a period of at least 12 months and meet the definition of "derelict" as specified in the Code of Virginia 15.2-907.1 (City of Richmond, 2025). The dataset also includes information about property ownership, along with associated contact and mailing information. A second dataset was obtained from the City of Richmond of city-owned parcels designated as "surplus." These properties were also included for consideration in the land inventory. Both property datasets were initially mapped as point features and subsequently converted into a polygon layer using a parcel boundary dataset provided by the City of Richmond (*Figure 4*).

Figure 4

Zoomed-in mapped subset of abandoned properties and city-owned surplus propertied.

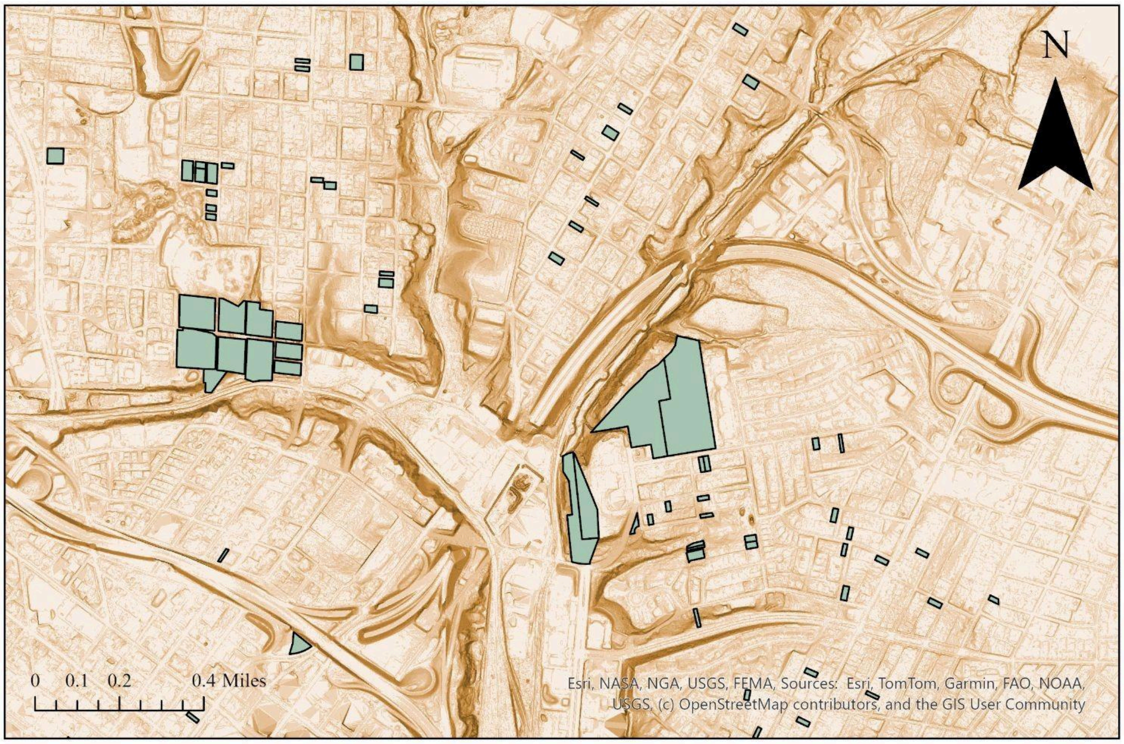


In existing site assessments for UA, minimum parcel size requirements vary depending on the purpose and goals of the study. For example, community gardens can function on smaller parcels because individual plots are typically managed by residents. However, larger parcels generally allow for more efficient agricultural production. Most site assessments evaluating UA for individual or community use propose a minimum parcel size of 4,000 square feet (Kremer & DeLiberty, 2011; Fun et al., 2024; Kamali, 2025), and this threshold was applied for the purposes of this study. Relatively larger UA site size can be important for practicality and maximizing efficient allocation of resources necessary for agriculture.

Slope is another land attribute that was considered when evaluating sites for UA. According to existing literature, the maximum suitable slope for planting generally ranges from 15% to 20% (Fun et al., 2024; United States Department of the Interior, 2006). For slope calculations, 1-meter resolution slope data were obtained from the United States Geological Survey's (USGS) National Elevation Dataset (NED). USGS Digital Elevation Models (DEMs) are derived from "high-resolution light detection and ranging (LiDAR) source data of one meter or higher resolution" (USGS, 2024). In GIS, this data was downloaded as individual tiles, merged into a single layer, and an average slope was calculated for each of the previously identified parcels. Parcels were filtered to include only those with a mean slope below approximately 8.53° (equivalent to roughly a 15% slope) (Figure 5).

Figure 5

Expanded subset of parcels filtered for a 15% slope and minimum size of 4,000 ft ^{2} with combined slope rasters as base layer.

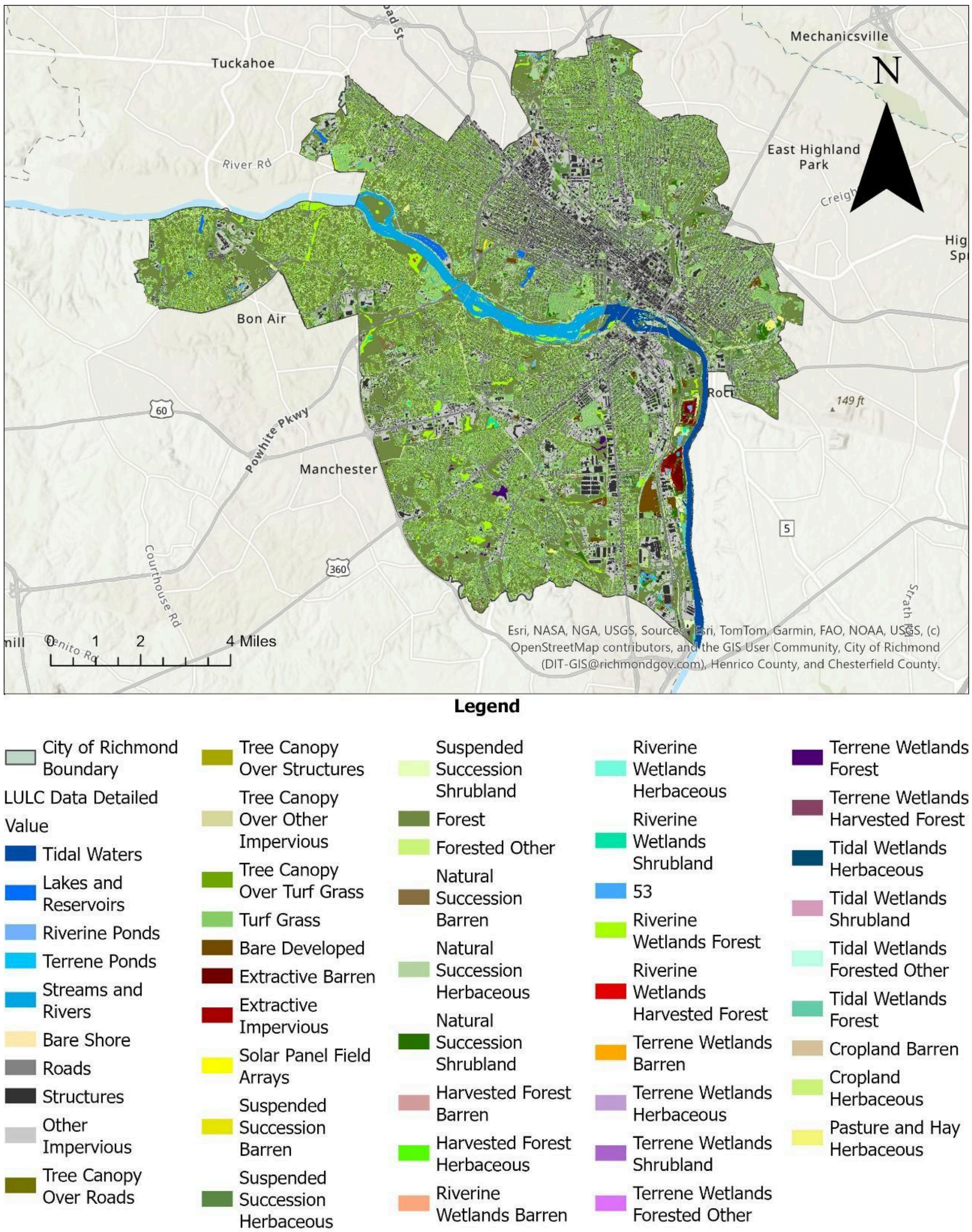


For the ground cover analysis of the remaining parcels, I used Chesapeake Conservancy's Chesapeake Bay Land Use/Land Cover (LULC) data. Ground cover or land use is a common criterion in many land inventories, due to the inability to farm impervious surfaces without extension remediation (Hastings, 2025; Kamali, 2025)

The LULC data is at a 1-meter resolution, allowing for a more detailed visualization of land cover. The data is separated into several schemas, each with their own classifications: Land Cover (11-Class, representing physical land surfaces), Macro Land (4-class, these are generalized classes for quick assessments); General Land Use/Land Cover (18 class, an aggregation of the 56 land use/land cover classes); Land Use (28-class, this represents land use), and Land Use/Land Cover (56-class, represents a combination of how people use the land and physical land surface). For the most detailed identification and analysis of suitable parcels, the Land Use/Land Cover classifications were used in this study. Each of the Land Use/Land Cover classifications were symbolized and applied to a map (Figure 6).

Figure 6

Map of Richmond, Virginia, with 56 differentiated Land Cover/Land Use Classes.



Parcels with specific land cover classifications were deemed unsuitable for UA: roads, structures, other impervious (human-constructed surfaces; e.g., sidewalks, parking lots), tree canopy over roads, tree canopy over structures, and tree canopy over impervious. These and similar impervious surfaces were eliminated for their inability to support agriculture without extensive remediation.

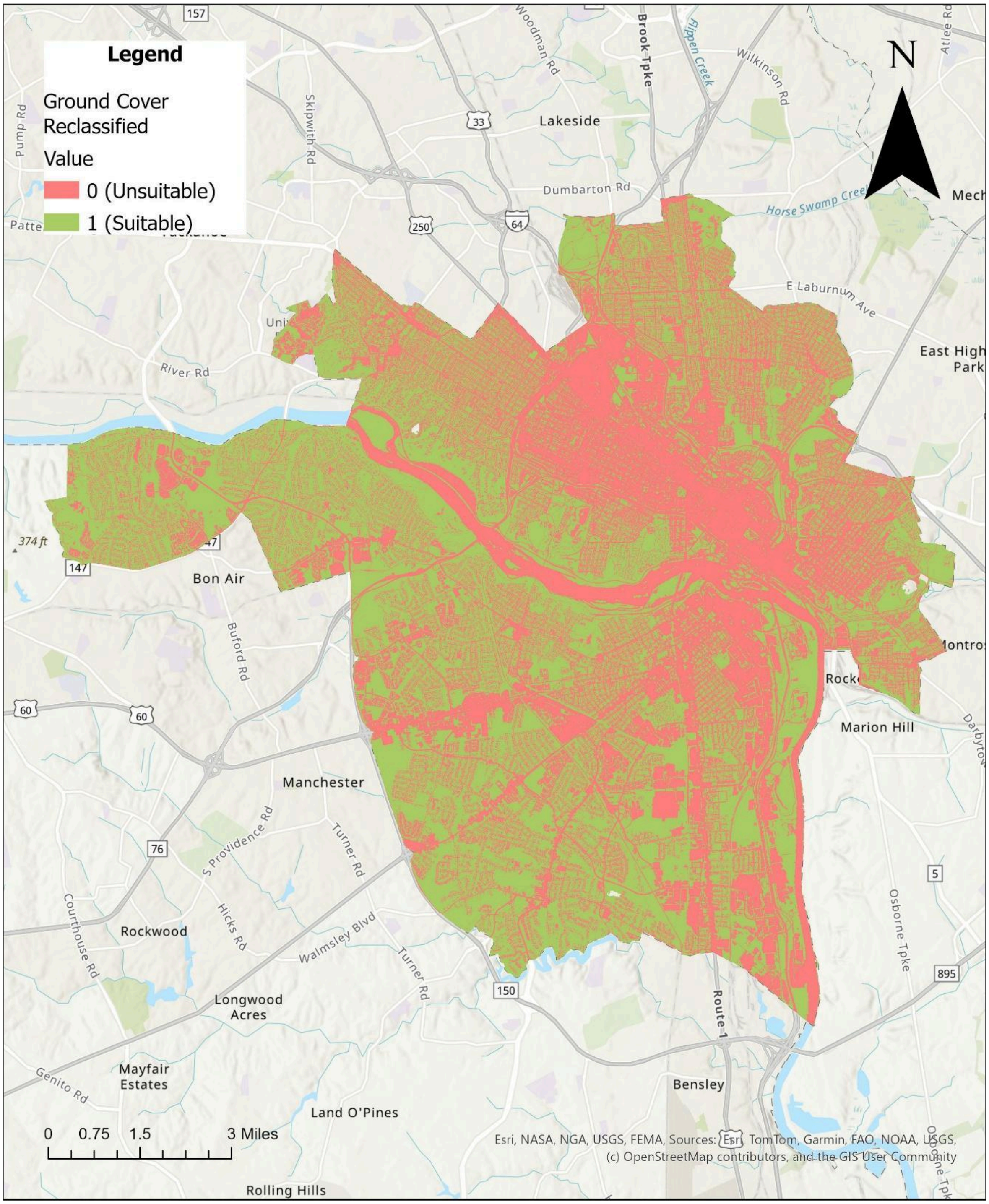
Due to the possibilities of raised-bed gardening and soil amendments, land cover categories considered “barren” (e.g., Natural Succession Barren, Cropland Barren) were included in the land inventory. Raised-bed gardening, which is proposed for this land cover analysis, allows for the cultivation of areas without sufficient topsoils and soil nutrients. Raised-bed gardening also addresses potential concerns regarding contaminants in urban soils (Kamali, 2025). To filter out sites containing a high proportion of unsuitable land cover, the 56 classes were reassigned a value of 0 (unsuitable) or 1 (suitable) (Figure 7). Parcels with over 25% of a land cover assigned the value of 0 were removed from the inventory. The remaining parcels are those with more than 75% of pervious and/or vegetated ground cover that allows for agricultural activity with minimal intervention.

Table 1: Ground cover category totals of eliminated parcels.

Ground Cover Class	Total area (ft^2)
Other Impervious	137,018
Structures	117,504
Roads	12,334
Tree Canopy over Other Impervious	4,528
Bare Developed	1,432
Tree Canopy Over Structures	855
Tree Canopy Over Roads	192

Figure 7

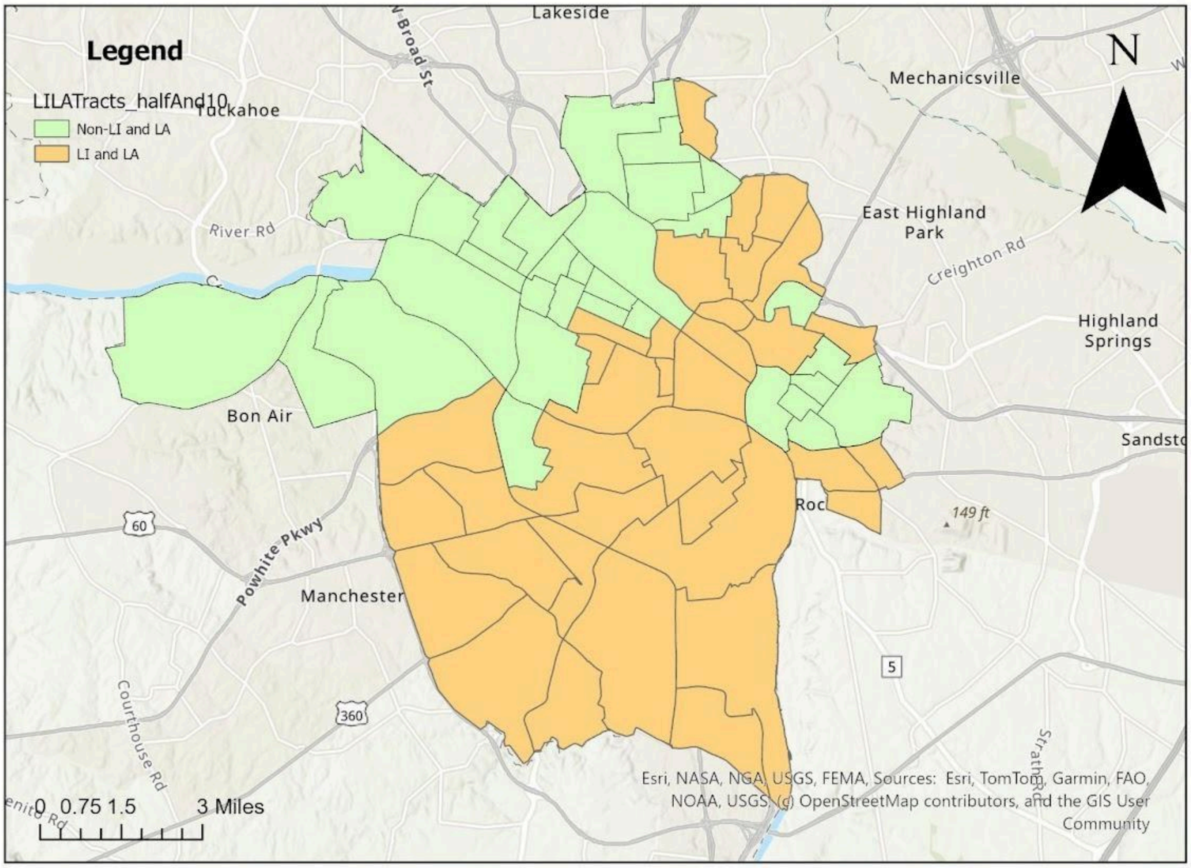
Land Use/Land Cover Classes reclassified for suitable (1) or unsuitable (0) for urban agriculture.



To incorporate criteria relating to indicators of food access, data was pulled from the USDA Food Access Research Atlas (USDA, 2025). The tool identifies food deserts through two main variables. The first is a measure of distance from retail establishments selling food (grocery stores). Tracts identified as low access are identified as those where a "significant number or share of residents" reside more than 0.5 or 1 miles (urban) or 10 or 20 miles (rural) from the nearest supermarket (USDA, 2025). The second variable is income level. Low-income tracts are those with a poverty rate of 20% or higher or a median family income less than 80% of the state or metro area median family income (USDA, 2025). For this filter, the indicator variables were set at low income and low food accessibility at 0.5 miles (urban) and 1 mile (rural) (*Figure 8*). 35 of the 66 City of Richmond census tracts fell within these low-income, low-access parameters. These indicators of access are commonly used to assess urban food accessibility in UA literature (Kamali et al., 2025; Meenar, 2012; Smith et al., 2021). Sites located outside these low-income, low-access census tracts were eliminated from the land inventory, leaving 76 sites remaining.

Figure 8

Map of census tracts identified as low-income and low-access (orange). Census tracts that do not qualify as both low-income and low-access symbolized in green (USDA, 2025).



4. Results and Discussion

This section presents the findings of the spatial analysis conducted to identify potential sites for UA projects in the City of Richmond, followed by an interpretation and recommendations for future directions for UA establishment. The discussion section evaluates these findings in the context of furthering food equity in the city and reviews the limitations of spatial analyses.

4.1 Results

The initial map of privately-owned, abandoned parcels and city-owned surplus parcels resulted in a total of 636 sites totaling 9,827,381.80 square feet of land. The initial parcel data points were mostly concentrated in the city's south side and north side (*Figure 9).* Applying minimum size criteria to the original dataset of 636 parcels removed 200 parcels, leaving 436 parcels remaining, with an average parcel size of 21,309.00 ft^2 (Table 2). Applying a minimum slope filter removed another 20 parcels from the inventory, leaving 416 sites for further consideration, with a mean area of 19,632.48 ft^2 (Table 2).

Filtering sites with more than 25% of undesirable ground cover (paved surfaces, water, buildings) eliminated the highest number of parcels, leaving a remaining 97 parcels with an average size of 28,758.51 ft^2. A high number of parcels (319 parcels totalling 5,377,536.24 ft^2) were disqualified from the land assessment when filtering for ground cover. The total amounts of each land cover class from the eliminated parcels are displayed in Table 1. The largest land cover class from the eliminated parcels is "Other Impervious," which is comprised of "human-constructed surfaces (e.g., sidewalks, parking lots, field-mounted solar panels, and rail lines) through which water cannot penetrate, and that are less than ~2 meters in height" (McDonald et al., 2025).

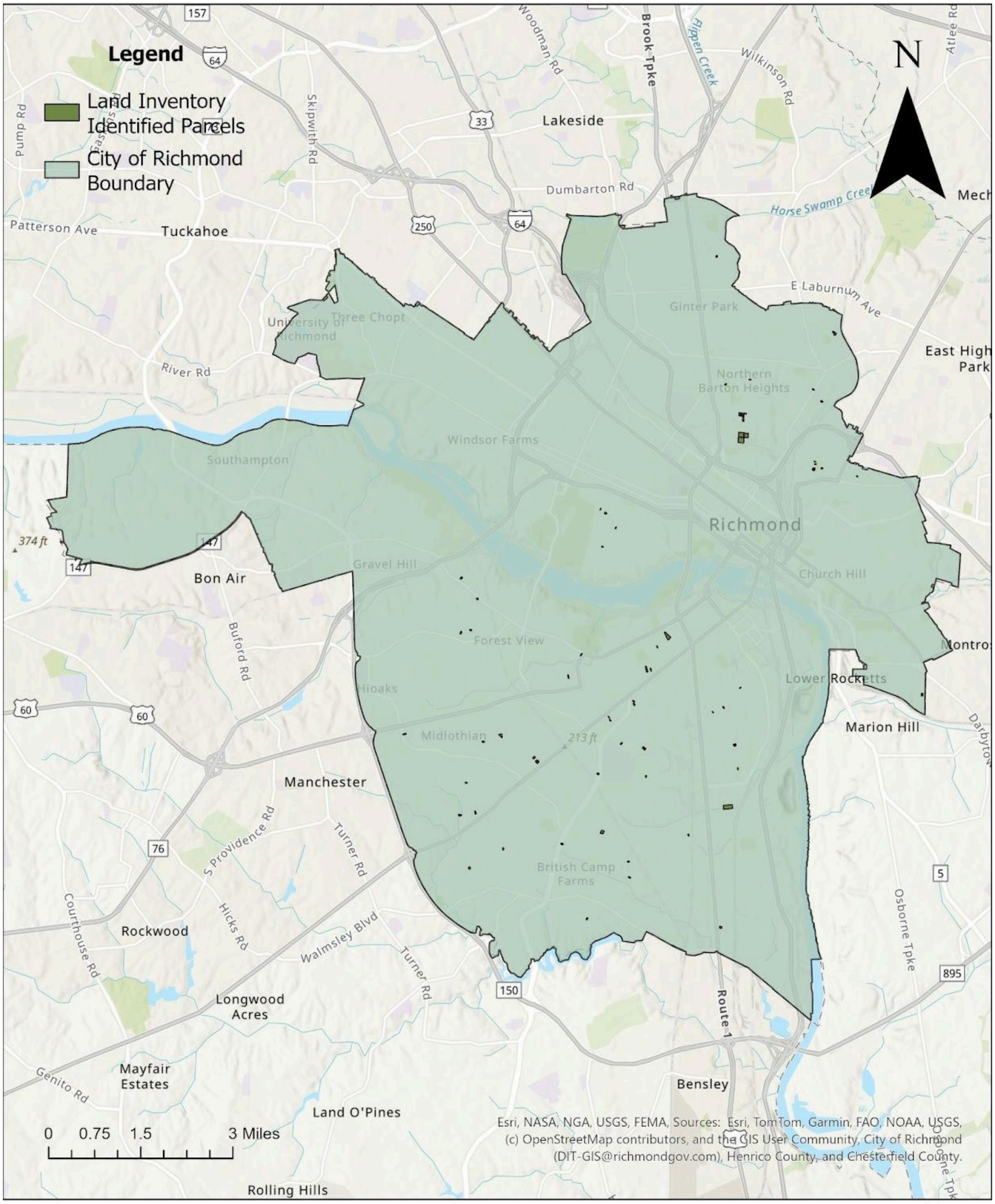
Table 2: Suitable Parcels totals after applying criteria.

Criteria	Number of Parcels	Total Area (ft^2)	Average Parcel Size (ft^2)
Initial Land Dataset	636	9,827,382.00	15,452
Initial Land Dataset + Land Size	436	9,290,867.00	21,309.00
Initial Land Dataset + Land Size + Slope	416	8,167,111.78	19,632.48
Initial Land Dataset + Land Size + Ground Cover	97	2,789,575.54	28,758.51
Initial Land Dataset + Land Size + Ground Cover + Food Access Indicators	76	1,412,320	18,583.16

Filtering for ground cover produced a total of 97 unused or surplus land parcels with suitable land attributes for agriculture in the City of Richmond, Virginia.

Figure 9

Mapped land inventory of sites within the City of Richmond limits.



A random sample of four parcels was selected and identified using aerial and Street View imagery to confirm the validity of the parcel results (Figure 10). Through the visuals provided by aerial and street view imagery, sites were assessed using the checklist from the Detroit Vacant Property Campaign guidebook used for visually identifying vacant properties (Detroit Community Legal Resources, n.d.). Some visual indicators included in the checklist are posted notices on the doors or windows of the building, boarded windows, neglected yard maintenance, and missing structural components of the building. All sites selected in the randomized sample fulfilled at least one abandoned building indicator in the checklist, except for site #1 where characteristics were not applicable due to the absence of a structure on the site (Table 3).

Figure 10

Randomized sample of parcels produced from land inventory criteria filtering. Addresses of the randomly selected sites, clockwise: 2510 LynHaven Ave (Site #1), 1702 Stoney Run Parkway (Site #2), 109 Carnation St (Site #3), and 1972 Barlen Dr (Site #4).

Table 3

Visual Indicators of property abandonment (Detroit Community Legal Resources, n.d.).

Visual Indicator	**Site #1**	**Site #2**	**Site #3**	**Site #4**
Posted notice on the door or window	N/A	N	N	Y
Building is boarded up	N/A	N	Y	Y
Yard maintenance is neglected	N/A	Y	N	Y
Excessive mail at doorstep/mailbox	N/A	N	N	N
"For sale" signs	N/A	N	N	N
Building missing key structural components	N/A	N	N	Y
Building is burned or showing significant deterioration	N/A	N	N	N
Building is significantly tagged or vandalized	N/A	Y	N	N

Note: Site #1 did not have a building or structure present, therefore the abandoned building indicators are not applicable to this selected site.

4.2 Discussion

The findings of this project identify potential sites for UA expansion and demonstrate the potential of integrating open-source data with GIS-driven spatial analysis to screen and analyze identified sites. The resulting 76 parcels provides a list of designated abandoned and surplus sites with suitable physical characteristics suitable for agriculture via slope, size, and ground cover. The sites located in "food deserts" were isolated for an equity-based UA approach. The resulting sites have a strong overlap with census tracts receiving low health opportunity scores and well as census tracts most strongly affected by the urban heat island effect (Hoffman, 2017). This overlap underscores the importance of an equitable approach to UA: establishing UA in areas with lower social, health, and economic outcomes can stand to benefit from UA the most.

Existing UA scholarship informed the selection of criteria incorporated into the land inventory. These selected criteria and following inventory provide an opportunity to evaluate identified sites on a tract-by-tract basis and incorporate additional data as well as stakeholder input. This assessment is limited in that it incorporates only basic criteria for supporting UA, but does not provide a ranking of sites, which is necessary for efficient, targeted implementation of UA. Stakeholder input could assign weights to additional criteria via MCDA, allowing for a more informed approach to UA establishment that best addresses community and resident needs and preferences. Potential stakeholders include local agriculturalists, residents, government officials, and food-access-oriented non-profit organizations (Hastings, 2025). It is recommended for further study that stakeholder input is incorporated via AHP to determine criterion weights and TOPSIS to be used to rank alternatives. This would allow for qualitative stakeholder input to be effectively combined with quantitative evaluation, best informing the site selection process.

Another limitation of this study is the use of census-block level data. While this was the most detailed data available, this can exclude residents who are outliers in their census block dataset. For example, eliminating sites outside of low-income census blocks neglects to consider low-income residents living in relatively higher-income census blocks.

It is critical to establish UA in spaces and through methods that benefit all residents, not only those who participate in UA projects. Even those who do not participate in urban gardening programs can benefit from the green space, improvements to air quality and biodiversity, and lessened effects of urban heat islands that UA provides (Cameron et al., 2012; Stacy et al., 2020; Taylor & Lovell, 2012).

One consideration to note is that aesthetic improvements to lots and efforts to combat urban blight can drive up property values—potentially displacing residents—and make neighborhoods more attractive to outside investors (London et al., 2020; Newell et al., 2022). This is why it is critical for UA to be accessible and tailored to residents. Identifying areas of need, rather than only areas where UA is likely to succeed, is essential.

This site evaluation assumes the use of raised-bed cultivation, given the cost and involvement of extensive soil testing required for in-ground agricultural practices and the relative ease of adding soil amendments and delineating plots, making it a cost-effective option for UA (Kamali, 2025). Raised-bed gardening is a common practice in community gardens (Nagai, 2014). However, if alternative UA methods are implemented, some criteria may become irrelevant. For example, rooftop gardens—a popular approach in many UA projects—do not require impervious ground cover; in such cases, the "structures" ground cover classification could be isolated for further analysis. The land inventory can be modified to account for these alternative methods.

Given the constraints of land availability in urban areas, sites excluded from the inventory due to unsuitable criteria may still be viable for alternative agricultural approaches.

Evolving techniques and technologies used in small-scale UA will only serve to expand the potential of food production in urban areas. For instance, sites eliminated for slope could be adapted through terrace or contour farming or by installing vegetative barriers to reduce erosion and retain soil moisture. Sites excluded due to a high proportion of impervious surfaces could support greenhouses, hydroponic operations, or container gardening (Nowak, 2004). Alternatively, investment in the removal of paved surfaces could be considered for UA establishment.

4.3 Future Directions

This land assessment is a list of preliminary sites that can be used for future site choice of UA projects in Richmond. Sites can be ranked, classified, and prioritized with the addition of stakeholder input and in-person site visits to assess suitability. It is difficult to account for every criterion impacting UA suitability, and therefore, it is necessary for criteria to be prioritized according to the goals of individual UA projects and the needs of individual communities. Community surveys can be used to identify interest levels, potential barriers to engagement, and crop preferences. Outreach is also a critical component for UA success (Huq & Deacon, 2025).

Many of the structures on the land inventory sites are in various states of disrepair and neglect. As a means of reaping the public health, environmental, social, and economic benefits of UA, the City of Richmond government could invest in demolishing uninhabitable structures or other unused impervious surfaces that are in disrepair to expand potential parcels for urban gardening. This would also help combat urban blight within the city.

To further equitable implementation of UA within the City of Richmond, I recommend the following:

- Consult stakeholders (local agriculturalists, residents, government officials, and food access-oriented non-profit organizations) for further criteria selection and ranking/weighting of criteria
- Perform individual site assessments, including in-person visits, soil testing, and identification of required resources (water hookups, sun exposure, etc.)
- Explore leasing options for privately-owned parcels and petition the city to demolish unused, dilapidated buildings to make use of underutilized space
- Publication of this land inventory, along with the associated data of individual sites, for UA participants to select preferred site criteria.

Existing UA spatial assessments primarily focus on inventories of publicly-owned or privately-owned "vacant" properties. However, to broaden the area of study, occupied residential land should be considered for UA implementation. Many urban residents, particularly in Richmond, have access to yards, alleyways, sidewalk medians, and other unused green spaces, all of which can be used for UA. Outreach to residents with land access should be explored as a method of expanding UA, as the combined spatial areas of these private spaces are often significant (Lal, 2020). Many studies that incorporate private residential lands as well as public utilize

To expand the search for potential sites of UA, this land inventory could be modified to incorporate private and/or residential land by eliminating the filter isolating vacant and abandoned addresses. Instead of isolating registered vacant or abandoned parcels, the ground cover data can be clipped to a residential parcel layer (available via the City of Richmond website) to identify residential green spaces with the appropriate ground cover classifications. The resulting layer could be filtered for size and slope, and land parcels meeting these requirements would serve as sites of potential UA.

5. Conclusion

While individual UA projects primarily supplement, rather than fully supply, the produce needs of urban residents, comprehensive UA policies and initiatives have the potential to strengthen and shorten local and regional food systems. In light of threats posed by climate change to agriculture, such initiatives are more critical than ever. Effective UA planning requires careful selection and application of site evaluation criteria, informed both by existing scholarship and local context. By integrating GIS-based analyses with stakeholder input, planners can identify potential sites that not only support successful cultivation of food, but also improve economic, environmental, and social resilience in urban environments.

Community engagement is also a critical component of UA. This paper demonstrates that a structured, criteria-driven approach to site evaluation can support more strategic and focused UA implementation. By combining the produced spatial analysis with stakeholder perspective and expertise, urban planners and policymakers can foster UA systems that strengthen local food security, enhance community resilience, and promote social equity across urban landscapes.

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