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Assessing the Spatial Connection between Urban Agriculture and Equity

MAHBUBUR R. MEENAR

This paper investigates the relationship between spatial planning and urban agriculture (UA) – primarily community gardens and market farms – through an equity lens. Significant research has been done on the benefits and challenges associated with UA, focusing on community food security, social justice, and community development; however, the spatial distribution of UA projects and the relationship between their form and the fabric of the urban built environment requires additional research. Using data from the City of Philadelphia, this paper explores two questions. First, what is the spatial relationship between UA projects and food-insecure neighbourhoods? Second, how does UA form and landscape fit within the urban built environment? Answering the first question involved GIS-based spatial analysis and statistical tests to explore the relationship between UA access and areas with high food insecurity. Answering the second question led to the development of a spatial-typology of UA projects based upon GIS analysis and a qualitative visual inspection process, allowing for discussion on how various forms of UA fit within urban landscapes. Results show that siting UA projects may lead to spatial mismatch issues, and most unstable or temporary UA projects are located in high food-insecure neighbourhoods. By exploring the connections between urban food production, land use, spatial planning, and the built environment, the design of more equitable urban spaces may be achieved.
municipal administrations did not support the cultivation of vacant land (Nordahl, 2009). Due to unfavourable policies and regulations, discontinued incentive programmes, land price increases, and development pressures, many decades-old UA projects that had become anchor institutions in lower-income communities were eventually closed or bulldozed (Cahn, 2015; Gottlieb and Joshi, 2010, p. 147). As result, UA has been mostly considered as patchwork – disconnected from other built features, or a placeholder – a temporary, interim, or informal land use (see Cahn, 2015; Horst et al., 2017; Meenar et al., 2012).

Significant research has been done on UA projects and policies in the last two decades. One major research stream examines household- and community-level benefits and challenges associated with UA (see reviews by Horst et al., 2017; Santo et al., 2016). Another stream focuses on the built environment and spatial distribution of UA using GIS technology (see Kremer and DeLiberty, 2011; Parece et al., 2017). The intersection of UA, the built environment, and spatial planning, however, is vastly unknown. This paper attempts to fill this gap with the aim that such understanding may contribute to designing equitable food environments.

The paper seeks to answer two questions:

1. What is the spatial relationship between UA projects and food-insecure neighbourhoods?

2. How does UA form and landscape fit within the urban built environment?

The goal is to examine whether UA projects are equitably distributed throughout the city, including food-insecure and vulnerable areas. I start with a brief overview of benefits, challenges, and current practices related to UA planning and design in the USA. Data, methodology, analysis, and results based on research in Philadelphia, USA follow, concluding with a discussion of major findings and recommendations.

Spatial Planning and UA Projects: Current Practices

Why is UA Important to the Community?

Research shows UA projects address urban socio-economic problems including community food insecurity, economic inequality, and inner-city disinvestment (Blair et al., 1991; Macias, 2008; Meenar and Hoover, 2012; Meenar et al., 2012). UA projects increase nutritional knowledge, create restorative spaces, promote physical and mental health, increase quality of life, and build human, social, organizational, financial, and physical capital in their communities (Hodgson et al., 2011; Kingsley and Townsend, 2006; Meenar, 2014; Meenar, 2015). Additionally, UA provides environmental benefits such as increasing biodiversity (Taylor and Lovell, 2014) and stormwater drainage (Wortman and Lovell, 2013); recycling organic waste (Brown and Jameton, 2000); and reducing air pollution (Janhäll, 2015) and urban heat island effect (Wolf and Robbins, 2015).

UA with diverse physical forms and social, environmental, and economic benefits can provide neighbourhood amenities and contribute to a positive community image (Mukherji and Morlales, 2010). Strategically locating UA projects is important because they can function as neighbourhood beautification tools or outdoor community centres. Furthermore, they can reduce crime (Kuo and Sullivan, 2001), increase social bonds, community efficacy, and networks among people with diverse background and power status (Alaimo et al., 2010; Firth et al., 2011; Kingsley and Townsend, 2006; Teig et al., 2009), and play a positive role in the most vulnerable communities (see Brown and Jameton, 2000; Okvat and Zautra, 2011; Saldivar-Tanaka and Krasny, 2004).

UA and Spatial Planning

UA projects can be as small as a few raised beds or as big as many acres of farmland;
they can be located in different types of land uses such as residential, institutional, parks and open spaces (Meenar et al., 2012). From a spatial planning perspective, UA projects are typically presented as components of a city’s recreation and open space plans, part of rural heritage preservation, or a major use for a city’s underutilized or vacant property (Felsing, 2002). While urban parks and play areas are usually designed by city governments in a way that follows a citywide planning initiative, UA projects are not designed or distributed that way; most are designed and operated by a group of individuals, non-profit organizations, businesses, or institutions.

Urban planners with various specializations (i.e. food systems planning, spatial or physical planning, land-use planning) interact with UA. Land-use planners, for example, find UA interesting but challenging due to the potential conflict between UA and other more high-value land uses such as housing or commercial development (McClintock et al., 2012). Spatial planners focus on sustainability and food access issues following current ‘planning trends’ of interdisciplinary practice and mixed-use urban forms (Vitiello and Brinkley, 2014). In many communities, planners and city officials have started conversations around UA, land tenure, and land banks (Meenar et al., in press). The following paragraphs present examples of four major ways spatial planners incorporate UA in their practice: through integration with urban infrastructures, planned unit developments (PUDs), edible landscapes, and housing projects.

Planners, in collaboration with landscape architects, blend UA with urban infrastructure, i.e. alternative transit, green design, open space/wildlife corridor design, and stormwater management. Examples include the use of UA projects as green stormwater infrastructure in New York City (Cohen and Wijsman, 2014). Some PUDs integrate community gardens, organic farms, and community-supported agriculture into housing developments, increasing home values, community identity, and character. Examples include pocket gardens on the Lower East Side of New York (see Mukherji and Morales, 2010).

Examples of edible landscapes include Seattle’s Beacon Food Forest, a non-profit-government collaboration consisting of a 7-acre (2.8 ha) edible park, Philadelphia’s Orchard Project, which works with community-based groups and volunteers to beautify vacant properties while providing access to fresh food in low-income neighborhoods, and Davenport’s (Iowa) edible landscaping project, which incorporates UA as design elements of public plazas, parking lots, and streets, making UA accessible to everyone (Nordahl, 2009).

UA has been used to address equity issues as some city governments are encouraging developers to build public housing projects that include community gardens, greenhouses, hydroponic systems, and rooftop orchards. Serving as a model, Via Verde in the South Bronx, New York, influenced the city’s healthy building design guidelines (Kolley, n.d.), and became an inspiration for similar projects across the city. A study conducted in 2004 by EcoCity Cleveland called for the need to change urban development process from ‘housing OR community gardens’ to ‘housing AND community gardens’, and identified housing and UA as collaborative, not competing, components of a healthy community (DiMarco Kious, 2004).

These examples underscore the need for planners and city administrators to understand connections between spatial planning, UA locations, and equity. Literature suggests that UA can be beneficial for the most vulnerable communities due to their potential social-economic-environmental benefits, but do these communities have easy access to UA projects, projects that are big enough to serve many residents, projects that have permanent access to land and other resources, or projects that have planning and administrative support to be sustainable? Equity issues around UA have been primarily discussed from a food justice perspective (see...
the loss of hundreds of UA projects over the last few decades include unfavourable UA policies and regulations, discontinued incentive programmes, development pressures, generational succession, and abandonment (Meenar and Hoover, 2012). Most UA projects in the city are not protected; however, the Neighborhood Garden Trust (NGT) has close to forty UA and ornamental gardens protected via land trusts. Most UA projects in the city are operated by strong advocacy groups, community-based organizations, and for-profit farms (Cahn, 2015; Meenar, 2015). The city has a Food Policy Council and food issues are generally recognized in city- or region-wide studies and plans.

My research questions required two independent analyses, which are presented in the following sub-sections. Data for 386 UA projects were available, including community gardens (n = 368) and market farms (n = 18). UA location data were collected from the Garden Justice Legal Initiative in 2012 and mapped using a geocoding tool. My field visits to all UA project locations in 2015–2016 yielded 353 active projects, including thirty-one protected NGT projects. Other GIS base data (i.e. parcel boundary, land use) were collected from the City of Philadelphia and Delaware Valley Regional Planning Commission.

Analysis 1: Equitable Spatial Distribution of UA Projects

In order to analyze UA’s spatial distribution in Philadelphia’s 384 census tracts, tracts were ranked according to their level of access to UA projects, a variable termed UA_ACCESS. Three categories of distances from UA project locations were calculated in GIS according to their level of convenience; locations within a quarter-mile (0.4 km) of UA, locations within a mile (1.6 km) of UA, and locations further than a mile from UA. A quarter mile is commonly considered a reasonable walking distance (see Gordon et al., 2011), and 1 mile has been also considered...
as convenient access by some researchers (see Berg and Murdoch 2008). These categories were ranked 3 to 1 (high to low), representing the most convenient/walkable access to the least. Analysis followed the methodology used in Meenar (2017) that used a raster-based Euclidean Distance tool, available under the Spatial Analyst tools of ArcGIS ArcToolbox. The resulting raster layer of 100 ft\(^2\) (9.3 m\(^2\)) cells, was reclassified into three categories: 1,320 feet or 0.25 mile (0.4 km), 5,280 feet or 1 mile (1.6 km), and the default 57,939 feet (17.66 km), representing the analysis extent (Philadelphia). The resulting map showed the pattern of UA access throughout the city.

To further understand whether UA projects are equitably distributed in different parts of Philadelphia, I compared UA_ACCESS ranks with ordinal ranks of the same tracts, derived from the Place-Based-Food-Insecurity-and-Vulnerability Index (PFIVI) (Meenar, 2017). The PFIVI Index was developed as a participatory spatial planning tool to design urban food environments. It incorporates six indicators to identify tracts with residents facing high levels of hunger and food hardship, lower access to healthy food retail, poor food habits, chronic health conditions related to food, lower community engagement, tracts containing at-risk population (e.g. low-income populations, people of colour, and foreign born population), and vulnerable places (e.g. areas with high crime and vacancy). Based on PFIVI score, Philadelphia’s tracts were categorized in three ordinal scales – high, medium, and low level of food insecurity and vulnerability (Meenar, 2017). Chi-square and gamma tests were then used to compare PFIVI values with UA_ACCESS values of all census tracts to identify possible mismatches or equity issues related to UA spatial distribution in the city.

Analysis 2: UA Spatial-Typology, Built Environment, and Equity

In order to understand the connection between UA forms and the built environment, I categorized Philadelphia’s UA-projects according to a spatial typology and then made a comparison with PFIVI scores. Scholars have developed categories of UA projects according to their operations (see McClintock, 2014), but there was no existing UA spatial typology available, at least for Philadelphia.

A spatial join of the UA shapefile and the Philadelphia land-use and parcel shapefiles, provided the parcel size for each UA project, identified the land-use category of each parcel and the surrounding area, determined whether the parcel was on a corner of a block, and identified adjacent UA projects. Next, based on a visual inspection of recent ortho-photography available on Google Maps and a review of field verification notes, the extent of UA activity on the parcel and other pertinent information related to its spatial characteristics and its connection to the surrounding built environment were recorded. Finally, a master spreadsheet documenting these data for each UA project allowed for identification of types or themes that were emerging. For example, 137 UA projects were situated on one or two lots, mostly in a residential area, and frequently with UA on the entire parcel; a category ‘Small’ emerged to represent these projects. All categories were developed based on a qualitative assessment of how closely UA projects could be grouped. Once the typologies were developed, a qualitative assessment of possible relationships between UA project types and three PFIVI-ranked census tracts was applied to understand if there is any spatial connection between these typologies and community food insecurity and vulnerability.

Results

The first analysis identified 154 census tracts (about 40 per cent of the total tracts) with high access, 162 tracts (42 per cent) with medium, and 68 tracts (18 per cent) with low access to UA projects. Figure 1 includes two maps displaying ordinal ranks of tracts...
based on \textit{PFIVI} and \textit{UA_ACCESS} scores. The embedded table shows that the relationship between \textit{PFIVI} and \textit{UA_ACCESS} is significant at the 0.01 level (obtained chi square, $X^2 = 16.24$ ($p < 0.00$) significant (df = 4, $\alpha = 0.01$), Gamma = 0.25). High \textit{PFIVI} tracts are more likely to have high UA access (48 per cent) than low \textit{PFIVI} tracts (32.3 per cent). As indicated by gamma (0.25), this is a positive relationship; however, the relationship is only moderately strong at best. Spatial mismatch was prominent in ten census tracts with high \textit{PFIVI} scores but low \textit{UA_ACCESS} scores. Conversely, 40 tracts with low \textit{PFIVI} scores had high \textit{UA_ACCESS} scores.

The second analysis yielded six major spatial typologies for Philadelphia UA projects: ‘Small’, ‘Corner’, ‘Large’, ‘Residential Complex’, ‘Existing Open Space’, and ‘Institutional’; ‘Other’ captured projects which did not fit these typologies. The ‘Small’ (n = 137) typology is explained in a previous section. ‘Corner’ (n = 86) projects are larger and often located on several adjacent lots and/or on a corner lot; these projects are mostly in residential areas, often with UA on the entire parcel. ‘Large’ (n = 32) projects are suburban sized and often located on the outskirts of the city or on vast amounts of vacant land (e.g. a whole block); UA on all or most of the parcel is common. ‘Residential Complex’ (n = 9) projects are associated with a housing complex. ‘Existing Open Space’ (n = 58) projects are situated within a park,
recreational space, arboretum, or cemetery. Finally, ‘Institutional’ (n = 29) projects are associated with a school, church, or other institution.

Table 1 provides additional information on these UA types, along with examples of each type of UA projects featured in figure 2. The maps of figure 2, all drawn at the same scale, display the existing built environment around UA projects, including buildings, utilized green spaces, rivers, rail tracks, and large paved surfaces.

More than half the ‘Small’ and ‘Corner’ type UA projects are located within tracts with high PFIVI ranks. ‘Large’, ‘Existing Open Space’, and ‘Institutional’ projects are mostly seen in medium PFIVI-ranked tracts. ‘Residential Complex’ type UA are equally distributed in all three PFIVI-ranked tracts. ‘Existing Open Space’ features the lowest number of UA projects located in tracts with high food insecurity and vulnerability. Only three NGT-owned UA projects can be categorized as ‘Small’; these are located in high or medium PFIVI tracts. Other types of NGT projects are distributed among all PFIVI tracts almost equally. Analysis of projects by land-use category revealed that 126 UA projects were sited on vacant residential land, the most for any land use. Other common

<table>
<thead>
<tr>
<th>UA Spatial-Typology</th>
<th>Description</th>
<th>Count (n = 353)</th>
<th>Percentage (of 353)</th>
<th>Approximate Parcel Size Range</th>
<th>Example (reference to figure 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>A project situated on one or two lots, mostly in a residential area, oftentimes with UA on the entire parcel</td>
<td>137</td>
<td>39</td>
<td>400–2,000 ft² (37–186 m²)</td>
<td>Farm 51 (fig. 2A), South St Community Garden (fig. 2B)</td>
</tr>
<tr>
<td>Corner</td>
<td>A larger project – oftentimes located on several adjacent lots and/or on a corner lot – that is situated mostly in a residential area, oftentimes with UA on the entire parcel</td>
<td>86</td>
<td>25</td>
<td>2,000–10,000 ft² (186–930 m²)</td>
<td>Aspen Farm Community Garden (fig. 2C)</td>
</tr>
<tr>
<td>Large</td>
<td>A suburban-sized project, often located on the outskirts of the city or on vast amounts of vacant land (e.g. a whole block), oftentimes with UA on all or most of the parcel</td>
<td>32</td>
<td>9</td>
<td>10,000–320,000 ft² (930–29,730 m²)</td>
<td>Greensgrow Farm (fig. 2D), Eastwick Community Garden (fig. 2E)</td>
</tr>
<tr>
<td>Residential Complex</td>
<td>A project associated with a specific housing complex, oftentimes an apartment complex</td>
<td>9</td>
<td>3</td>
<td>2,500–58,000 ft² (230–5,390 m²)</td>
<td>Garden Court Community Garden (fig. 2G)</td>
</tr>
<tr>
<td>Existing Open Space</td>
<td>A project situated within a park, recreational space, arboretum, cemetery, etc. (associated with some type of public/civic space)</td>
<td>58</td>
<td>16</td>
<td>1,000–14,550,000 ft² (93–1,351,740 m²)</td>
<td>Schuylkill River Park Community Garden (fig. 2F), Manatawna Farm/Garden (fig. 2I)</td>
</tr>
<tr>
<td>Institutional</td>
<td>A project associated with a school, church, and other institution</td>
<td>29</td>
<td>8</td>
<td>1,000–1,860,000 ft² (93–172,800 m²)</td>
<td>MLK High School Garden (fig. 2H)</td>
</tr>
<tr>
<td>Other</td>
<td>None of the above (e.g. rooftop gardens)</td>
<td>2</td>
<td>1</td>
<td>35,000–210,000 ft² (3,250–19,500 m²)</td>
<td>—</td>
</tr>
</tbody>
</table>

Total | 353 | 100 | — | — |
Spatial mismatch issues exist in 50 census tracts, of which 10 with high PFIVI scores have no convenient access to UA projects.

As food insecurity and vulnerability increase in a tract, access to UA increases, possibly because UA projects act as interventions in those high-PFIVI tracts; another explanation is that there is more vacant land available for UA in those tracts. The positive relationship between UA_ACCESS and PFIVI suggests that, in general, census tracts with limited or no access to fresh food receive the most interventions through UA projects; however,

Discussion and Concluding Remarks
This equity-based analysis addresses two questions – how UA projects are spatially distributed, and how UA blends with the surrounding built environment. UA projects in Philadelphia can be found in many parts of the city, and generally serve food-insecure areas characterized by low-income populations, people of colour, and refugees.
these projects are not limited to areas with food insecurity and vulnerability. Many factors unrelated to the PFIVI index may influence the establishment of a community garden or a market farm, including community interests, community capacity, land suitability or availability, and capital needs for urban farming (see Meenar, 2015). Of the 18 per cent of Philadelphia census tracts without easy access to UA, 10 have the highest PFIVI scores. Located in North (n = 8) and Southwest (n = 2) Philadelphia, these tracts contain at-risk residents facing high levels of hunger and food hardship, lower access to healthy food retail, poor food habits, chronic health conditions related to food, and lower community engagement.

In order to explore UA’s connection with the built environment and spatial planning, a spatial-typology of UA projects was developed. Most small- or mid-size projects are located in food-insecure residential areas, often on vacant lots. High PFIVI tracts generally have a higher percentage of vacant lots, potentially explaining the reason behind the concentration of ‘Small’ and ‘Corner’ type UA projects. This trend is problematic, because these projects are rarely on protected land, often considered a temporary land use, and feature limited organizational structure. ‘Existing Open Space’ type UA projects are uncommon in areas with the highest need for permanent or protected UA projects potentially due to a lack of open space.

Analysis of how UA integrates with the built environment through an equity lens yielded compelling results. Even though more UA projects are found in low-income areas, they are the most vulnerable among all UA typologies developed. Vulnerability of a UA project may stem from being seen as a temporary land use, location near vacant lots inviting vandalism and other crimes, or being managed with limited organizational structure. These conditions only work to further reinforce the inequities – whether related to community food security, food access, community engagement, community capacity, or access to parks and open spaces – that already exist in these areas (see Meenar, 2017).

These findings are important, as they may help us understand why UA projects need to be (i) considered within the dialogues around spatial planning and equity, and (ii) incorporated into the planning process more formally to promote the design of more equitable urban spaces and projects. In particular, food planners as well as land banks and other not-for-profit organizations may think more critically about the distribution and impact of planned UA projects. The findings may also prove useful in pursuit of external funds to initiate green infrastructure projects in high PFIVI areas.

The development of a spatial-typology of UA projects and the accompanying dataset for Philadelphia may also prove valuable for both existing and future UA projects. Projects with similar typologies may assist one another in facing similar problems; additionally, successful projects and ideas may be exchanged. Long-term, this study may help identify why some projects are more successful than others. Lastly, this dataset may be used to inform policy decisions.

While the key findings and methodology are transferable to other similar cities, the limitations of this study leave room for future research. The spatial distribution analysis considered all projects equally, regardless of their size, type, operation, longevity, and vulnerability. The focus has largely been on access or spatial distribution, not how many local people are involved in such projects and in what capacity. To expand the concept of UA typology from a spatial to a comprehensive one, a future study may include additional spatial and non-spatial factors such as UA site plan and design features, proximity and access to public transportation, access to produce distribution, population density of surrounding areas, location type (e.g. downtown, neighbourhood, and outskirts), user profile (e.g. open to community, membership-based), type of ownership, and
ancillary services offered (e.g. community education, workshop, demonstrations, tours).

Researchers have shown that community capacity plays an important role in the spatial allocation of green infrastructure in disadvantaged urban communities (see Mandarano and Meenar, 2017); however, UA projects are designed differently from parks or other green infrastructure. Local residents, local culture, community efficacy, community capacity, organizational capacity, and partnerships play a big role in starting and maintaining a UA project (Meenar, 2015; Teig et al., 2009). Longevity or vulnerability of UA projects is dependent on local government policies and regulations, lease time, and community buy-in. A future study may examine the connection between UA locations and community capacity, analyzing issues of community buy-in, power structure, and racial-exclusion.

As a legitimate and beneficial land use with deep historical roots, spatial planners and design professionals should pursue UA by working with municipal governments to identify land bank properties (wherever applicable) and un/underutilized public land suitable for UA (e.g. utility areas, schools, libraries, hospitals, public housing, recreational spaces, preserved spaces, food/earthquake prone areas). Sustaining UA projects beyond the project grant period or initial community interests is a significant problem tied with land tenure problems. Food systems planners, designers, and policy-makers need to design ways to support experimentation in both historic and new UA projects by working closely with food-centric non-profit and grassroots organizations.

REFERENCES


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